THE AMERICAN JOURNAL OF ROENTGENOLOGY

Editor, H. M. Imboden, M.D., New York.

VOL. V (NEW SERIES) OCTOBER, 1918 No. 10

ON THE INSTRUCTION OF WAR ROENTGENOLOGISTS

BY MAJOR RENE LEDOUX-LEBARD

Chief of Radiologic Service, Hospital Descartes, Tours, France

AMONGST many other new developments due to war conditions, the capital importance of roentgenology as a primordial factor in diagnosis, surgical treatment, and medico-legal decisions must rank first in our interest. It has given rise to a quantity of problems involving physical technique, medical and surgical technique, as well as general organization—problems which it is our duty as specialists to examine carefully and to help in solving.

In regard to physical technique it can safely be asserted that considerable progress has been made and that owing to the fruitful collaboration of such physicists as Coolidge, Hull, and Shearer we are in possession of equipments that will meet all requirements for the work to be done on the front as well as in the interior.

In surgical technique, where the localization of foreign bodies with all its consequences has a long time been the main center of interest, we can also consider that the problem, which had of course been solved theoretically long ago, is now very adequately solved from a practical view also—a few very simple fluoroscopic methods being sufficient to give a rapid and accurate answer to every possible question that may arise (with the single exception of intra-ocular foreign bodies). The surgical extraction with the aid of the "bonnette" is their complement. Many other points—diagnosis of gas, gangrene, et cetera—have received due attention and lead up to important results. But it seems as if the questions regarding the general organization of war roentgenology have elicited less interest amongst members of our specialty though they undoubtedly are of a very vital importance at the present moment.

The first question to be solved is how to supply the armies with roentgenologists. I am not at liberty to state any positive figures but I can well say that with the actual war conditions, and the ever increasing quantities of men on the front, a very considerable number indeed of roentgenologists is required if we want—as we undoubtedly do—to afford every possible facility for the proper care of the wounded. And this number of roentgenologists outstands by far the number of men already in the specialty even if every roentgenologist was actually available for service.

We have, then, no other alternative than to form new roentgenologists in quantities sufficient to meet the ever growing requirements of the army; and this is no mean task. It demands care and reflection and should command the greatest interest and personal collaboration of all engaged in the specialty, as it requires a

considerable and persistent effort, the difficulties of which can only be realized by those who have already had a hand in this instruction.

Two conditions are to be fulfilled, in my opinion, by any man enlisting as a military roentgenologist: (1) He must be a fully qualified medical man. (2) He must take real interest in this specialty and in this kind of work; for only those who "take to it" are able to do it well and it must be done well or not at all.

If several hundreds of roentgenologists (satisfying the above two conditions) are wanted for the armies fighting in France it implies, of course, that the greater number of them will be entirely new to the specialty and will have to be "formed" and instructed.

The difficult problem of this "formation" seems to have been solved very satisfactorily, and indeed in the only way that could bring good and rapid results.

The theoretical and practical instruction that has been given to all of those whom I have had the pleasure of seeing in France is of a standard which I acknowledge with admiration and which ought really to give wonderful satisfaction to the men who have devoted their time and efforts to this instruction.

But some practical training in war work is needed by those who were not already specialists, and to this part of the instruction I have given all my attention, having had the great honor of being entrusted with an important part of it.

Conditions of work on the front are of course altogether different from our civil practice and can only be fully realized by those who have been "in it." *There*, roentgenology is practically limited to fluoroscopic examination in which the search for and localization of foreign bodies play the most important part. Mastering a few simple yet accurate methods of fluoroscopic localization must be the dominant occupation of the roentgenologist. He must also be prepared to aid the surgeon in extracting the foreign bodies in the difficult cases either with a compass—the Hirtz compass—or, if a roentgen table is available (and it nearly always is), with the aid of the "bonnette," which means team work with the surgeon. Preliminary personal experience with a few cases is here a necessity for good and rapid work and this experience I have been able to give, thanks to the willingness of our surgeons and especially of Professor Ombiedanne, to all the men who have been under my care in Tours.

The gross study, with the screen, of traumatic bone conditions, and their complete and more delicate observation on the plates, is the next objective in the interest of the war roentgenologist and is readily gained owing to previous general instruction. The knowledge of gas gangrene, traumatic chest conditions, et cetera, is also essential.

But owing to the difficulties in transportation, equipments are not and *cannot* be uniformly distributed. Furthermore, the complex amalgamation of the Allied Forces in actual warfare will often locate roentgenologists of the A. E. F. in a place where French or English roentgen ray equipments alone are available, where Coolidge tubes are unknown. He must therefore be prepared to work with gas tubes and with any form of coils and interrupters.

Preparedness for this emergency is our third principal object in this practical training and is, I believe, readily attained. And this also points out the necessity of simplifying and standardizing equipments to the utmost possible limits. Simple, but of light weight and easy of transportation must be our outfit—conditions which seem well nigh realized, thanks to the persevering efforts of physicists and manufacturers. These have given so constant and hearty a collaboration to the roentgenologists entrusted with the huge task of getting our part of the enormous war system into work. The U. S. Army portable outfits, with the small radiator Coolidge tubes, seem to be an ideal solution of this question.

Last I must mention the importance, for all those engaged in any war work over here, of some knowledge of the language and I need not dwell on its too obvious reasons. The small glossary, which appears on page 483 of this issue, is an endeavor to help out to some extent, however modest, in this line and is only a suggestion for further efforts. This knowledge may greatly facilitate a correct written interpretation of the roentgen findings. The importance of a correct and adequate written statement is considerable and only too often overlooked. I lay great stress upon this point as well as upon a correct classifying and indexing of roentgen findings. A small pamphlet on this subject will shortly be published which, I hope, will be of some help to those not yet quite familiar with the task.

I have indicated but a few of the points which I believe to be important for practical education and complementary instruction of war roentgenologists and I apologize for having dwelt on such commonplace subjects—subjects so well known to all of you.

As a result of my actual experience, I think I can safely state that thanks to the splendid efforts of those who have had the care of roentgenological teaching in the United States,—and to the persevering and incredible energy and activity of those who, like Lieutenant Colonel Case, Major Hickey, Lieutenant Waters, and all the men who have been over here with them —it is possible to form under five months' time, roughly speaking (three months' instruction; one month of practical training in France; and one month for transportation), a series of men who, undoubtedly, will not become in this short interval perfectly and fully qualified roentgenologists unless they were specialists before, but who will be quite able to undertake practical work under the very best possible conditions for the benefit and care of our wounded and the final triumph of our just cause.

I feel proud of having been entrusted with a part of this work. It has brought me into close contact with so many able men in all of whom I have admired the spirit and willingness for self-sacrifice; and has strengthened, if that were possible, my sympathies and admiration for my American colleagues.

THE BRONCHIAL TREE*

ITS STUDY BY INSUFFLATION OF OPAQUE SUBSTANCES IN THE LIVING

BY CHEVALIER JACKSON, M.D.

PHILADELPHIA, PA.

THE wonderful development of stereoscopic radiography has rendered it possible for the expert roentgenologist to see the trachea and, in many patients, some of the larger and some of the smaller ramifications of the tracheobronchial tree, the latter more especially in cases in which more or less pathology is present. A method for increasing the visibility of the tree is a great desideratum. The author believes that intrabronchial insufflation of opaque substances meets this requirement and opens an enormous field for investigation.

The method consists in insufflating or injecting an opaque substance or mixture into the living tree. The injection of the tree in the cadaver has been done many times, and in a few instances opaque solutions have accidentally gotten into the trachea or bronchi from the esophagus, either by overflowing into the larynx or by leaking through a cancerous fistula.[1] Naturally, no one would care deliberately to inject the living tree, unless either (a) the absolute harmlessness of the method were proven, or (b) there was a reasonable hope of bettering that particular patient's con-

[1] BEELER, R. C., *J. Am. M. Ass.*, 1915, LXV, 1178.

* Read before the Meeting of the Laryngological, Rhinological and Otological Society, May, 1918.

dition at no more than slight risk. Indisputably to prove absolute harmlessness, a large number of observations on all sorts of patients will be necessary; and this evidence must come primarily from the second class of observations, namely, those in which there is a reasonable probability of benefiting a patient not otherwise relievable.

Since his first publication[2] in 1907 the author has, in a number of cases, deposited a small amount of bismuth in the bronchi for the radiographic localization of a particular spot, to show the relationship of the spot to a foreign body that was itself not in view, and for the localization of bronchiectatic and abscess cavities, and so forth. In none of these cases was there any after-trouble from the bismuth. In using the method in a case where we obtained the mapping out of a considerable portion of the tree of one lung, Dr. David R. Bowen, with whom I was collaborating, suggested the advantage of stereoscopic plates in such a case.

In the case of a young man, twenty-three years of age, with a metallic foreign body "around the corner" in an ascending branch of the left upper-lobe bronchus, bismuth subcarbonate was blown in with an insufflation tube (see in the accompanying illustration). A radiograph, taken by Dr. David R. Bowen within five minutes after the insufflation, showed a mapping out of the stem bronchus, the upper-lobe bronchus, and some of the branches. One of the bronchi was plugged by the bismuth and caused me some uneasiness, until a radiograph taken by Dr. Bowen twenty-four hours later, showed that all the bismuth had disappeared. Occasional cough and expectoration for the first six or eight hours was rather free, the sputum being of milky whiteness from admixture of bismuth. At the end of twenty-four hours cough and expectoration ceased, and the patient has been normal ever since getting rid of his foreign body. The plugging of a bronchus by the bismuth is doubtless less likely to occur with the bronchoscopic insufflator (see in the figure), but the relative merits of each method have not as yet been fully worked out.

Conclusions.—1. In intrabronchial insufflation with opaque substances, in the living, we have a measure of the greatest usefulness in mapping out the tracheobronchial tree in foreign-body cases where a foreign body is far in the upper-lobe bronchi, or in other small bronchi that cannot be entered by the bronchoscope. A stereoscopic pair of radiographs will show the bronchi *in situ* in the living, and the bronchi can also be followed in the fluoroscope.

2. The intrabronchial insufflation of dry bismuth subcarbonate through the bronchoscope, in sufficient quantities to cast a shadow, did not produce any untoward symptoms, and the bismuth totally disappeared from the lung by expectoration in twenty-four hours.

3. The insufflation of dry powders and the injection of opaque fluid mixtures through the larynx give a degree of visibility to the trachea and larger bronchi in the radiograph; but the results are not as good as when the insufflation of a dry powder is done through the bronchoscope.

4. The method opens up an enormous field for investigation of the action of the living cilia, in health and disease, the lymphatic drainage of the lung, the mapping out of bronchiectatic and abscess cavities, and so forth.

[2] JACKSON, CHEVALIER, "Tracheobronchoscopy, Esophagoscopy and Gastroscopy," p. 69.

LOCALIZATION OF THE LOBES OF THE LUNGS BY MEANS OF TRANSPARENT OUTLINE FILMS

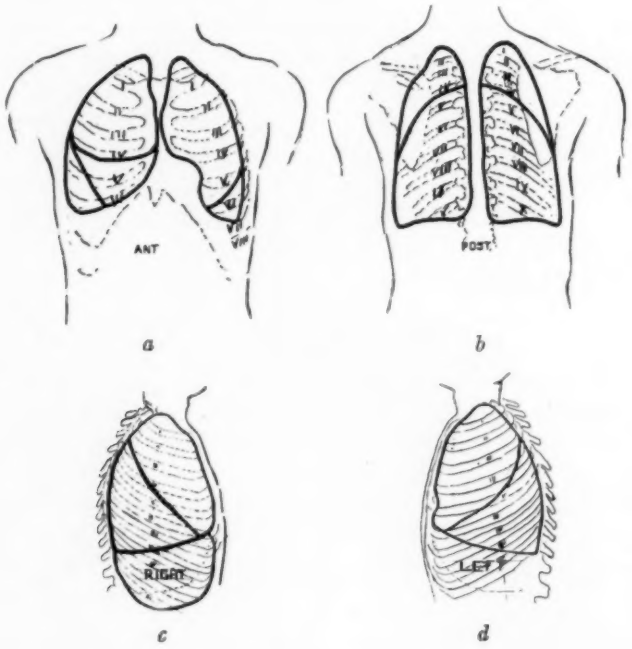
BY CHEVALIER JACKSON, M.D.

PHILADELPHIA, PA.

CLINICIANS have a very good working conception of the size, shape, and topography of each of the five lobes of the lungs, in the living. But when a foreign body is seen in a radiograph there is often a difference of opinion as to which lobe the intruder is in.

In the case of a foreign body in any of the larger bronchi, bronchoscopic finding is a very simple matter. In those infrequent cases of a foreign body, small in one diameter—such as a pin—and located in a small bronchus far out toward the periphery, the finding of the foreign body may be facilitated by very accurate localization. The author's transparent positive films have been of great aid in these cases.

In a number of cases of small foreign bodies far out toward the periphery, transparent outline films for overlaying the radiographic negative have been of great service to me. Twelve sizes of each of four points of view are needed: front, back, right lateral, and left lateral (see *a*, *b*, *c*, and *d* in the accompanying illustration).



a *b*

c *d*

Knowing the lobe invaded, the bronchoscopist limits his search for a lost foreign body to the branches of the stem leading to that lobe.

Conclusions.—For mapping out the outlines of the lobes of the lungs in a radiographic negative, the overlaying of the plate with a transparent positive outline film is very useful. It is necessary to have about twelve sizes of outline films of each of four points of view: front, back, right lateral, and left lateral. These, with a moderate mental endowment of solid geometry, will be of great help in localizing the outlines of the confusingly irregular labor shapes.

SOME CAUSES OF FUNCTIONAL DISABILITY FOLLOWING FRACTURES

BY H. W. DACHTLER

TOLEDO, OHIO

DURING the last six years I have made a systematic effort to reëxamine fracture cases which I had previously examined since 1900, with the object of determining the end result and, where functional disability was present, of ascertaining the cause, if possible. Since 1900 all plates have been filed and records kept of the original examinations so that the actual condition at the time of the injury could be studied, and comparisons made. It seemed that if a sufficient number of these cases could be reëxamined, material well worth study would be furnished. This expectation has been proven to be correct by the remarkable results shown in some of these cases. The total number of cases examined from 1900 to date for suspected fracture was in round numbers 5000. The percentage of fractures found in this series was not determined, as no cross index of that feature was made. Of the total number of original cases over three hundred have been reëxamined, some of them a number of times. These, together with the cases first seen by me some time after the injury had been sustained but not examined with the *x*-ray at the time of injury, form a series from which some important conclusions regarding loss or impairment of function can be derived. An effort has been made to learn the ultimate functional result of other cases that could not be secured for reëxamination. No attempt has been made to classify numerically the different types of fractures but they will be considered regionally.

In fractures of the metacarpals good function seems assured if reasonable reduction is obtained. A few cases were seen in which reduction was difficult but usually ordinary methods were adequate. One case was seen in which there was a positive history of fracture of the second, third, fourth, and fifth metacarpals in a patient aged nineteen. When examined forty years later no evidence of fracture or change in the bone structure could be detected. The hand had been dressed with the hand clasped around a cylinder about two inches in diameter.

The typical automobile fracture is a fracture of the radial styloid, and the fracture extends into the wrist joint. Usually there is no displacement and but slight separation, and just what injury the periosteum sustains I do not know, but it is probably slight. No callus is seen and bony union is slow. The fracture line can usually be seen two months after the injury and, in one case, was still present four years after the injury. Most of the cases examined from two to five years later showed a complete return to the normal bone picture. Most of the patients examined were young men in perfect physical condition in whom rapid repair would be expected. Fixation should not be applied in these cases unless the fragment is displaced and then for a few days only, following reduction. The ultimate function is practically perfect. Not all fractures caused by an automobile back-firing are of this type, some being typical Colles' fractures. The exact nature of the injury must be known to be intelligently treated.

In Colles' fractures several important points seem conclusive. Eighty per cent. of these fractures show a marked bulging of the posterior part of the lower fragment of the radius, owing to the fractured end of the shaft being driven into it and causing comminution. The anteroposterior diameter of the wrist is increased just under the dorsal annular ligament. If the impaction is not broken up and the fracture reduced, this interferes with the use of the extensor tendons, and loss of function

may result. Usually, it is impossible to reduce an impacted Colles' fracture without giving an anesthetic, and even then it may be difficult to break up the impaction. If perfect reduction is obtained and the joint is immobilized for the length of time formerly thought necessary in treating these fractures, marked functional disability will certainly occur, and it may be months before a proper use of the joint is possible! If not properly reduced and fixation is applied for a few weeks, most certainly will loss of function persist for months and even years. As flexion of the wrist and fingers has been the hardest motion to obtain following such injuries, it is a strong argument for the use of the full-flexed wrist position recommended by the late Dr. John Murphy in treating Colles' fractures, even though there is no other indication for its use. It, however, offers the further advantage of retaining the fragments in accurate position, with less chance of displacement while bandaging than is possible by other methods. The ability to fully flex the wrist also shows that the posterior bulging of the lower fragment has been corrected. Excessive swelling may also prevent full flexion, and in such cases further *x*-ray examination will be necessary to determine if reduction has been obtained. The flexed wrist position is not a disadvantage in this examination, as it is only necessary to make the lateral view to determine if reduction is satisfactory. Of the many cases I have seen treated in this manner not one has had difficulty in extending the wrist afterward, and the normal function was obtained in a much shorter time than is usual after treatment in other positions. It should be noted, however, that in all these cases passive motion was begun very early. This is essential to good results. One who has noted the force necessary to break up the impaction in a Colles' fracture under anesthesia cannot but marvel at the fallacy so prevalent among physicians concerning the necessity of immobilizing such fractures as have not been reduced. If an anesthetic is contraindicated and crepitis is not present, they should be treated as sprains and no fixation applied.

FIG. 1. CASE NO. 6587B. LATERAL VIEW OF A COLLES' FRACTURE.

This is put up in the full flexed wrist position with moulder posterior plaster splint. At two weeks this patient was writing his records with this hand.

FIG. 2. CASE NO. 6587C. SAME CASE AS FIG. 1, TAKEN SEVENTEEN DAYS AFTER INJURY.

Before reduction this was one of the worst comminuted and displaced Colles' fractures in my experience.

They can be supported in a sling for a few days, at the end of which period the patient should be encouraged to use the joint. Nineteen cases were seen in which the fractures had not been previously recognized,

FIG. 3. CASE NO. 27180. SAME CASE AS FIGS. 1 AND 2, SEVEN YEARS LATER.

Function perfect. Plate still shows evidence of the old fracture line.

and the patients used the wrists from the time of injury. There was practically no loss of function in any of these cases, although some of them were considerably deformed. A large and varied experience with Colles' fractures treated by both old and new methods forces the impartial observer to the conclusion that the large percentage of cases with functional disability were due to the fixation applied and not to the injury. No lack of treatment can produce the absolute disability I have observed in cases of Colles' fracture where fixation has been continued for four or more weeks. Such procedure is still not uncommon.

Next to the wrist, probably the elbow is the joint of the upper extremity most often fractured. Will the study of these cases help us to understand why such good functional results follow elbow injuries in children and why some loss of function frequently follows injuries to the adult elbow? I think it will. Eighty per cent of the elbow injuries in children do not involve the joint at all. They are usually fractures of the lower end of the humerus entirely above the epiphysis, or a fractured condyle. In the first case, the joint is not seriously injured, and even with extensive displacement of the lower fragment and marked deformity no permanent joint disability is experienced. In the early days of the *x*-ray, many of these cases came in diagnosed as backward dislocation of the elbow and showed a marked tendency to recur after supposed reduction. They were never such! Elbow dislocations must be extremely rare in children, as only one case is found in the series on which these observations are based. Allowance must be made for cases that may never reach the roentgenologist, owing to ease of reduction. Only two cases of separation of epiphysis of the lower end of the humerus occurred in this series. One was not reduced, and the ultimate function will be noted if possible. When functional disability exists after elbow injuries in children, it is usually due to marked change in the carrying angle or to rotation of the lower

FIG. 4. CASE NO. 9256. UNREDUCED FRACTURE OF LOWER END OF HUMERUS IN PATIENT EIGHT YEARS OLD.

Picture taken five weeks after supposed reduction. (Plate by Drs. Hill and Thomas, Cleveland, O.)

fragment on the shaft of the humerus, which, uniting in such faulty position, causes some loss in supination. One case in which the normal carrying angle was replaced by an angle of twenty-five degrees in the opposite direction had perfect function of the joint but, of course, marked disability of the arm. Most of these fractures are best treated with the elbow fully flexed and with the palm to the shoulder. Occasionally a case is seen that can only be maintained in reduction with the arm fully extended. Such cases should be carefully watched, however. The good results in these cases are in marked contrast to the functional results following injury, especially dislocation, of the adult elbow. This is due to the fact that in the adult elbow it is the joint structures that are usually injured. The elbow, more than any other articulation, seems prone to new bone formations following slight trauma. This condition has been described under the title of "Traumatic Myositis Ossificans." The study of eight cases examined with the *x*-ray shortly after a minor injury in which no lesion was found was of much interest. These cases were reëxamined after varying intervals because of some loss of function which gradually progressed.

FIG. 6. CASE NO. 1842.

Forearm of boy, aged six years, examined three weeks after injury.

FIG. 5. CASE NO. 9256. SAME ELBOW FOUR YEARS LATER.

Picture shows how perfectly nature has corrected the deformity.

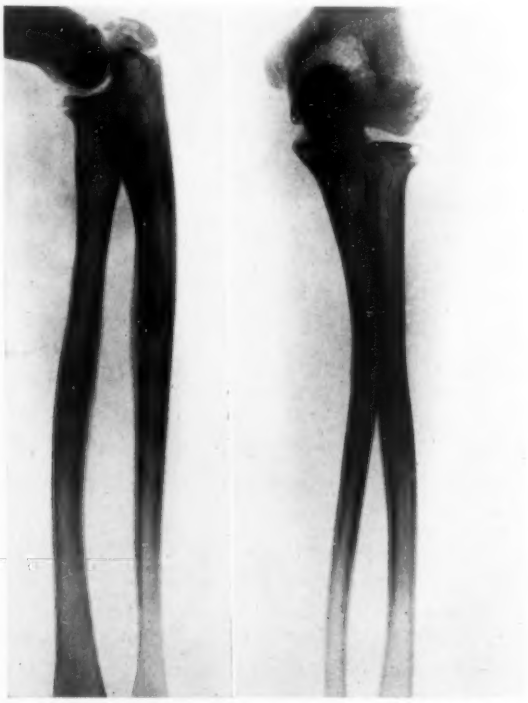


FIG. 7. CASE NO. 1842. SAME CASE AS FIG. 6, EXAMINED EIGHT YEARS LATER.

With the exception of slight bowing no evidence of the old fracture can be detected.

The disability was either some loss of flexion or extension associated with slight pain at the extremes of motion. In all of them new bone formations were present. In a few of these cases the new bone formations were so marked that a previous fracture would have been suspected if I had not had the original plates showing no evidence of injury. No matter how trifling the injury to the adult elbow I always caution the patient that later such formations may occur. In my experience locomotive engineers show a marked tendency to traumatic myositis ossificans. An injury breaking up the new bone formations will cause much pain and the limitation of motion, perhaps previously unnoticed, may lead to errors in physical diagnosis.

FIG. 8. CASE NO. 4859. FRACTURE AND DISLOCATION OF LUMBAR SPINE IN MALE AGED 23 YEARS.

The transverse processes of the first, second, and third lumbar vertebræ were fractured and slightly separated.

Fractures of the head of the radius are much more common than usually suspected. My experience with over one hundred and fifty cases is that the majority are caused in the same way that a Colles' fracture is sustained, by falling upon the extended hand. Pain on rotation of the forearm is marked, and extension and flexion are limited. Moderate extension or flexion may cause but little pain. Strange as it may seem, in a class of injuries due to the same cause, I have never observed a fracture of the head of the radius and a Colles' fracture in the same arm. One patient sustained a fracture of the head of the radius on one side and a Colles' of the other wrist. In some of these cases, the head of the radius is completely shattered, but the ultimate function will be good if the patient will persist in using the elbow joint.

Fractures of a condyle of the humerus seldom cause loss of function unless associated with a dislocation. Three cases associated with dislocation were seen in which the fractured condyle was drawn within the elbow joint, preventing reduction of the dislocation. Such cases are serious and may require operation for the removal of the fragment. Some loss of function has resulted in all of these cases.

Reference to the elbow joint would not be complete without calling attention to the fractures of the shaft of the ulna,

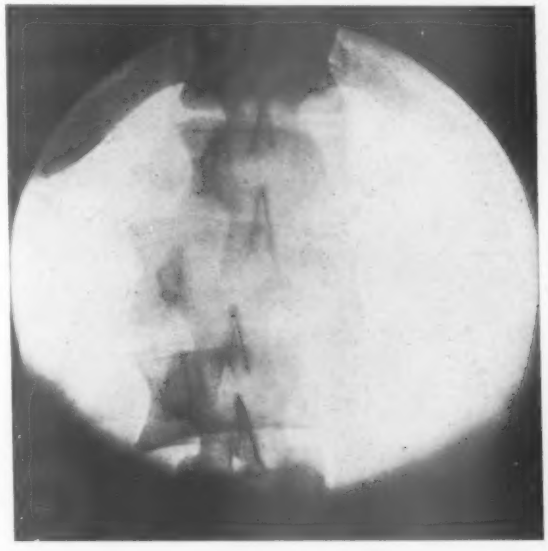


FIG. 9. CASE NO. 4859. SAME CASE AS FIG. 8, SIX MONTHS LATER.

Picture shows repair in spine and long union of transverse processes showing that the transverse processes will unite if not too widely separated. This patient has no paralysis and practically no disability.

with overriding of the fractured ends causing a dislocation of the head of the radius. This complication may easily be overlooked. One case was observed in which the dislocation recurred three times,

FIG. 10. CASE NO. 24004. UNIMPACTED FRACTURE OF NECK OF THE FEMUR IN FEMALE AGED 54 YEARS.

Picture taken four days after injury.

and the ulna had to be plated to hold it in extension before reduction of the dislocation could be maintained.

This series has not furnished anything striking in fractures near the shoulder. A large number of cases have been examined in which there was marked loss of function but no fracture. This is now known to be due to injuries to the soft parts, and, as a class, can be classified as sprains, although the injuries were of various kinds and degrees. In fractures of the surgical neck the extent of the injury to the soft parts will usually determine the loss of function. Two cases of fracture of the anatomical neck with displacement of the fragment, in which the fragments were resected, gave fair functional results.

Marked fractures and dislocations of the vertebræ can occur with surprisingly little disability. Two cases were seen, one with a crushing of the body of the eleventh dorsal and the other of a crushed first lumbar, in which the patients only complained of symptoms that suggested a slightly sprained back. In both cases only slight improvement was noted in four months. Fractures of the transverse processes of the lumbar vertebræ leave the patient with a lame back of which he complains for a long time.

Fractures of the pelvis have shown fairly good function. Some fractured pelves were found in examinations for renal calculi. In all of these the patients had been injured when young, but were not aware that they had sustained fractures. Most of them were caused by falling astride a fence or similar object. There was no evidence of disability in any of these patients, although some deformity of the symphysis pubis was present in each case.

One of the very important regions with which we have had to deal is the hip joint, and the three hundred odd cases of fracture

FIG. 11. CASE NO. 24004. SAME CASE AS FIG. 10, SIX MONTHS LATER.

Patient was treated, in hospital, by fixation without operation. Head and neck absorbed. Picture taken before patient had been allowed to use the limb.

in this location show some interesting and instructive features. One important fact that seems proven is that, in fractures of the neck of the femur that are completely intracapsular, and not impacted, old methods

FIG. 12. CASE NO. 11673. SPIRAL OBLIQUE FRACTURE THROUGH TROCHANTERS OF MALE, AGED 65 YEARS.

of treatment are worthless. Such cases do not go on to bony union, and, without exception, subsequent examination showed an absorption of the neck. When I see such cases I feel justified in saying that function and weight-bearing will not be secured unless the fracture be mechanically fastened or artificially impacted, and in recommending such procedure if the age and condition of the patient justify it. In no other way can the function of weight-bearing be conserved, and, if properly carried out shortly after the injury, good joint function and weight-bearing can be obtained. Fractures at the base of the neck of the femur are partly extracapsular and often impacted. The impacted cases have usually united and show good weight-bearing function after six months. The joint disability will depend upon the amount of shortening, the change in the angle of the neck and the amount of rotation present. Fractures through the trochanters unite in a remarkably short time. If shortening is slight, good function is assured. In some of these cases the lesser trochanter is markedly displaced, and, in these, function may be impaired.

Fractures of the knee are likely to result in some loss of function as very slight displacements may interfere with the weight-bearing ability of the joint or cause severe muscle strain. In addition, the ligaments and cartilages are often injured and, even when no fracture has been sustained, the joint is often permanently weakened. A guarded prognosis should be made.

The most important function of the lower extremities is that of weight-bearing. If good weight-bearing function without undue muscle strain is retained, locomotion is usually assured even though there be a stiff hip, knee, or ankle. Faulty weight-bearing with the attending muscle disability will most certainly cause loss of function. From the foregoing one would

FIG. 13. CASE NO. 11673. SAME CASE AS FIG. 12, SIX WEEKS LATER.

Bony union so perfect in this short time that fracture could not be detected.

expect angular deformities of the long bones or of the joints of the lower extremities to interfere most seriously with function, and this is borne out by my series of cases. Moderate overriding of the long bones and consequent shortening leaves but slight permanent disability. With overriding of the fractured ends and consequent shortening of the muscles there is much less tendency to angular deformities. A fracture of the middle third of the femur with the fractured ends overriding and in opposition, in which the long axes of the two parts are parallel, gives good function even though the shortening be as great as two inches.

FIG. 14. CASE NO. 10454. EXCESSIVE CALLUS FORMATION IN HIP OF FEMALE, AGED 42, FOUR MONTHS AFTER INJURY WHICH LED TO A CLINICAL DIAGNOSIS OF SARCOMA.

In all of the cases observed showing this condition, the shaft of the femur was in contact with the base of the neck and immobilization was not complete.

Fractures in the upper and lower thirds of the femur are particularly hard to handle. The method of treatment which best prevents angular deformities must be used, and bone plating may be necessary. Do not depend upon the plate to oppose the pull of strong muscles or you will be disappointed. Rather take as much strain from the screws as possible by placing the leg in a position to minimize the strain. Fractures of the femur just above the condyles are subject to displacement by the pull of the gastrocnemius, and the fractured end of the lower fragment is usually found in the popliteal space. In an early series of fourteen cases not one was reduced without an open operation. While many of them were plated, I do not think it necessary. In the adult, it is often impossible to reduce this fracture without some form of traction apparatus or by operation, prying the displaced lower fragment into place with a chisel or other suitable instrument. The tendency then is to plate to maintain reduction, and the leg is put up in plaster in extension or at best with some form of knee splint that allows only moderate flexion. This I think is absolutely contraindicated. It puts a

FIG. 15.

Showing proper angle for insertion of screw in mechanically fastening a fracture of the neck of the femur. In this position the weight of the body will not be borne by the screw but by the bone, the screw preventing the fracture ends from sliding on each other.

severe strain upon the screws used to fasten the plate. This strain should always be avoided, as far as possible, after plating operations. The logical way to treat these fractures would seem to be that used with

In fractures of the lower leg the most important consideration is to preserve the proper axis for weight-bearing and to prevent a lateral tilting of the ankle. I always make an anteroposterior plate of the ankle

FIG. 16.

Fracture of the lower end of the femur.

FIG. 17.

CASE NO. 23073.

Same case in plaster cast with leg fully flexed on the thigh.

FIG. 18.

Same case five weeks later when cast was removed. Ultimate function nearly normal.

such success in fractures of the lower end of the humerus, in which the arm is fully flexed. If the fracture is a transverse one, as is often the case, and the leg is flexed, the heel being drawn well back upon the buttock, all tendency to displacement is overcome, and plating or other fixation operation is unnecessary. If the fracture is oblique, a single peg or screw can be inserted if it has been necessary to open to reduce the fracture or, better still, extension can be applied to the condyles of the femur to overcome the shortening. If a cast has been applied, shortening can be avoided by keeping the knee upright in bed, allowing the weight of the leg to rest upon the bottom of the foot. Experience has shown this full-flexed position of the leg to be comfortable and to have no contraindications. This method has given good results in comminuted cases that, in my opinion, could not have been satisfactorily treated otherwise. (See Figs. 16-17-18.)

joint in leg fractures, as it is important in outlining the treatment. Many of these cases were formerly left with faulty weight-bearing that caused permanent disability. In Pott's fractures and other fractures near the ankle, do not neglect to examine the entire length of the fibula. In such cases, the fibula is often broken near the head and, sometimes, in both upper and lower thirds. It is often overlooked, and may result in slight loss of function.

It is with trepidation that I approach the subject of the operative treatment of fractures, having seen such extremes of both bad and good results. Truth compels me to say that many surgeons are poor carpenters. The surgeon wishing to do bone plating could profitably spend some of the time spent in surgical clinics in watching a cabinet maker at work. We have many times been treated to the spectacle of a screw half set, with the head so damaged that it was impossible to remove

it or to drive it home. Have you ever seen a surgeon try in a bone the drills and screws of a size he expected to use later in an operation? If they had done so, many of the failures I have seen could have been avoided. Some of the mistakes I have observed are as follows:

FIG. 19. CASE NO. 18561. FRACTURE OF THE LEG IN MALE, AGED 86, FOURTEEN YEARS AFTER INJURY.

Practically no loss of function due to the fact that ankle position is normal.

1. Not using a drill of the correct size for the screw used. This resulted in the screw not giving the proper fixation.

2. Using screws so long they passed entirely through the bone.

3. Using screws so thick they unnecessarily weakened the bone.

4. Screws placed too close to the fractured ends of the bone.

5. Short plates used on long bones with but one screw on each side of the fracture, which did not maintain proper alignment or fixation.

6. Plates used on bones too near the surface of the body.

7. Improper fixation and support after the operation, resulting in too much strain on the screws. Result: a broken plate or absorption of bone around the screws, causing them to loosen.

8. Careless handling of the patient after operation, causing the plate to be broken.

Notwithstanding the above, I believe bone plating a safe and, at times, a necessary operation.

Operation is indicated in cases in which reduction cannot be attained by other means *provided* reduction is necessary to secure function. A perfect anatomical result is not always necessary to secure good functional results. Operation is seldom indicated from the anatomical standpoint alone. If reduction can be maintained after operation, without mechanical fixation, the foreign body should be omitted. If mechanical fixation is necessary, then fixation must be absolute in order to prevent bone absorption around the screws. For this reason, wiring is seldom to be considered, as absolute fixation by this method is almost impossible. Only in rare cases is wiring indicated. Some types formerly wired can better be fastened by the use of small wire nails or brads. This is especially true of many fractures of the olecranon and of the condyles of the humerus and of some ankle fractures. Bone plugs require considerable manipulation to introduce, do not give fixation, and apparently offer no advantages. Fixation of the hip in intracapsular fractures is best done by forcible impaction or with one screw of the proper length. The angle in which the screw is inserted is of extreme importance. (See Fig. 15.) The screw should not be used to hold the weight of the body but to hold the fractured ends together in such a manner that the strain of weight-bearing is thrown upon the bone and not upon the screw. This is a very important point, and bone absorption is much less likely to occur under such circumstances. Bone is at least as difficult to work as hard wood, and at least the same care should be observed in working it if you wish to be successful.

Conclusions.—In Colles' fracture, treatment, and not the injury, is responsible for much of the loss of function. Under rational methods of treatment the eighty per cent. of cases with functional disability

FIG. 20. CASE NO. 27491. FRACTURE OF LEG IN MALE, AGED 27, WITH MARKED FUNCTIONAL DISABILITY DUE TO TILTING OF THE ANKLE.

formerly observed are practically eliminated.

The majority of elbow injuries in children will later result in perfect function of the joint.

Injuries to the adult elbow, especially dislocation, are quite often followed by new bone formations that impair the function of the joint.

In fractures of the skull all evidence of the fracture has usually disappeared within one year following the injury.

Fractures of the spine may easily be overlooked, owing to the slight disturbances present. Lateral plates are always necessary to exclude spine fractures.

In fractures of the neck of the femur it is important to know the exact nature of the injury, so that proper treatment can be instituted immediately. Delay in diagnosis will, in some cases, result in absorption of the neck and part of the head and will preclude operative treatment later.

In fractures of the lower extremity care must be taken to secure proper weight-bearing. If necessary to accomplish this, open methods of reduction and fixation are indicated.

Bone operations are major surgery of the highest type. They should only be undertaken by those having a proper conception of the technique, and with strict observance of the fundamental rules laid down by Lane. I think it well to add that unless a surgeon is possessed of considerable mechanical ability he is likely to fail.

The younger the patient, the nearer will be the return to a normal bone picture, following fracture. Marked deformities disappear entirely so far as bone structure is concerned.

The absolute disappearance of all signs of fracture and a complete return to normal, as shown by some of the cases, should cause one to be guarded in his statements and testimony in medicolegal injuries.

CONCERNING A ROENTGENOLOGICAL CONCEPTION OF PULMONARY TUBERCULOSIS*

BY FRANK S. BISSELL, M.D.

Assistant Professor of Roentgenology, University of Minnesota

MINNEAPOLIS, MINN.

INTRODUCTION.—That the roentgen examination of the lungs for the detection of the lesions of tuberculosis will ever become an exact science is doubtful. Most of the signs which have been described may be defined as highly characteristic but not infallible. Doubtless there are certain signs, such as Dunham's "fan" or "cone," which when present are pathognomonic, but the writer is the more convinced with increasing experience that no single pathognomonic sign is present in all cases of pulmonary tuberculosis.

Hence, in its present state of development, the roentgen diagnosis of tuberculosis should be regarded as an art which approaches scientific precision in direct ratio to the roentgenological experience and medical ability of the observer. The necessity of correlating roentgen signs with those elicited by physical examination and laboratory study thus becomes apparent. Without the proper coördination between roentgenologist and physical diagnostician the best results in the diagnosis of pulmonary tuberculosis are not possible.

Nor does this statement weaken the strong position of roentgenology in the field of lung diagnosis. It can and will remain the most important factor, without supplanting in any degree the methods of the internist in chest examination.

The roentgenologist who studies his stereoscopic lung roentgenograms with care will, however, find characteristic signs of active pulmonary tuberculosis in many cases which do not manifest the typical physical signs and clinical manifestations of phthisis. And this fact has led the method into much disrepute with many clinicians. It becomes highly essential, therefore, that a roentgenological report should offer more than a mere diagnosis of pulmonary tuberculosis. It should recognize the existence of variable clinical complexes with a common fundamental etiological factor, and should suggest, if possible, the probable complex or type to which the case in hand belongs.

To this end the writer has arranged the following table, attempting to set forth the roentgenological, clinical, and pathological characteristics of four types of pulmonary tuberculosis.

TABLE

Roentgenological	Clinical	Pathological
Type A		
1. Infiltration, peripheral.	1. Poor nutrition. Exhaustion with slight exertion.	
2. Infiltration, peribronchial.	2. Occasionally slight temperature upon exertion.	
3. Tendency to unilateral involvement.	3. No physical signs.	
4. Limited areas of involvement.	4. Reaction to subcutaneous tuberculin—focal, general, or both.	No data.

* Read before the Nineteenth Annual Meeting of The American Roentgen Ray Society, Chattanooga, Tenn., Sept., 1918.

TABLE—(Continued)

Roentgenological	Clinical	Pathological
Type A—(Cont.)		
5. Dunham fan not constant.	5. Improvement under tuberculosis management.	
6. Areas of previous involvement indicated by increased fibrosis.		
7. Progression from one area to another, shown by observations over period of years.		
8. Absence of cavitation.		
9. Absence of massive or conglomerate infiltration.		
Type B		
1. Fine soft shadows of infiltration both peripheral and peribronchial.	1. Temperature curve.	1. Infiltration.
2. Direct extension to hilus.	2. Intermittent physical signs.	2. Fibrosis.
3. Characteristic distribution in 1st and 2nd interspaces (preferably right).	3. Loss of weight with intermittent gains.	3. Pleuritic thickening, especially over apices.
4. Dunham fan more common.	4. Prompt tuberculin reaction	4. Noncaseating.
5. No cavitation.	5. Sputum frequently negative.	5. Absence of amyloid changes.
6. Marked fibrosis.	6. Favorable influence of climate.	6. Absence of cavities.
7. Progression to general involvement of one or more lobes.	7. Infinitely chronic.	
8. Localized density over apex (one or both).		
Type C		
1. Early signs similar to *Type B*.	1. Physical signs typical and early.	1. Infiltration.
2. Massive conglomerate shadows make early appearance.	2. Hemoptysis often occurs.	2. Caseation.
3. Marked tendency to cavitation.	3. Bacilli in sputum early and constant.	3. Cavitation.
	4. Progression unremittent.	4. Amyloid.
	5. Unfavorable response to climate changes or sanatorium treatment.	5. Fibrosis.
	6. Frequent presence of focal infection of tonsils or teeth (especially the former).	
Type D		
1. Absence of characteristic parenchymal shadows and of Dunham fan.	No clinical signs.	1. Calcification.
2. Areas or nodules of great density (calcification).		2. Fibrosis.
3. Broken lung fields (fibrosis).		3. Thickened pleura.
4. Evidence of pleuritic "cap" over one or both apices, with localized extension of fibrosis-like shadows into lung field.		

Type A may well be regarded as a distinct clinical entity, because it is accompanied by few of the clinical manifestations which characterize groups *B* and *C*. The disease appears to involve successively various areas of the lung fields, never rapidly or violently but insidiously. One rarely sees more than one or two of these areas actively involved at the same time but other areas usually show evidence of healed disease. This observation leads to the conclusion that the host is chronically and actively tuberculous, but that the process constantly tends to heal in certain areas as it progresses to others. That the process under discussion is in reality a tuberculous one, and that it is responsible for a long train of symptoms in the host, is a conviction based solely upon a mass of clinical and roentgenological experience from which is deduced the following evidence:

1. The host invariably reacts to 15 mgm. of old tuberculin administered subcutaneously—focal, general, or both. Conversely, all individuals in whom there is a focal reaction in the lung present the characteristic variations in their stereoroentgenograms.

2. The roentgenological signs observed in the stereogram are closely similar to or identical with those observed in known cases of relatively early pulmonary tuberculosis.

3. An indeterminate percentage of cases of *Type A* become changed to *Type C*, following exposure or some intercurrent infection.

The writer has observed a number of such apparent transitions, sufficiently great to suggest that this may be the usual sequence when active tuberculosis seems to develop under these circumstances. The probability is here suggested that the disrepute which the tuberculin reaction suffers in many quarters is due to the common reactions obtained in this type of phthisis, which, without roentgenological visualization, would remain a concealed process.

Discussion.—Many efforts have been made to explain general and focal reactions to tuberculin upon some hypothesis other than that of a tuberculous infection. These efforts seem to have lacked the power of conviction; whereas the close coordination of the focal reaction, at least, with roentgen signs of pulmonary involvement, strongly indicates that the tuberculosis explanation is after all the more correct one in most instances.

In *Type A*, as in *B* and *C*, the changes observed are predominantly unilateral and their earlier seat of choice is in the periphery of the 1st and 2nd interspaces, somewhat more frequently on the right side. It is doubtful whether the so-called cigarette-smoke-cloud effect is ever observed in this type, although it is a frequent characteristic of *Types B* and *C*.

The train of symptoms presented by cases of this group is that of any low-grade infection. Many of them are mistakenly diagnosed neurasthenia, and doubtless a large number of them have been improved or cured by the Weir-Mitchell Rest Cure.

Sufferers belonging to this group are worthy of our most careful consideration, because they are constantly seeking help from the medical profession, who, without roentgenological assistance, will continue to grope blindly, as in the past, for a diagnostic solution of their problem.

The roentgen signs, when typical, are not easily mistaken, and the diagnosis is no less conclusive because the disease fails to progress according to accepted clinical laws, which seem to govern only cases of *Type C*.

A weak link in the chain is an apparent absence of pathological data. This, however, may be due to the simple fact that these patients do not die until age has transferred them to group *D*, or until some other disease more interesting to the necrologist has made its appearance.

In *Type B* the host is more frankly tuberculous, both roentgenologically and clinically. The process extends more rapidly and consecutively than in *Type A*, and the tendency to become isolated and

to heal out is not so strong. Roentgen signs may be more prominent from the first. One never observes cavitation, unless it is that of a concurrent bronchiectasis.

Clinically this type may be characterized as a less violently active process than *Type C*. Sputum is not so easily obtained, and bacilli are not constantly present, although they are usually found if persistently searched for. To this type belongs the individual, with whom we are familiar, who often lives for many years in a fair state of health and well being, if he but remains in a well-chosen climate.

Roentgenologically, one soon learns rather distinctive characteristics of the type, which help in its proper classification. It is not claimed that such a differentiation can be made with scientific precision. One suggestive feature is a rather diffuse dissemination of the lesion through the upper lung at an early stage. The absence of any tendency to form conglomerate masses within the lung-field or to break down with resultant cavitation, and the evidence of a thick pleuritic cap over an apex also aid in the differentiation.

Type C offers such a marked contrast to *Types A* and *B*, from roentgen, clinical, and pathological standpoints, that one is forced to the conclusion that some new etiological factor has entered here. The observation of the pathologist that amyloid changes are observed in certain tuberculous lungs, usually in association with cavitation, may point to this factor, since it is well known that amyloid is found in the presence of pus infections. The writer believes that insufficient attention is given to focal infections as a complication of pulmonary tuberculosis. *There seems to be considerable evidence that the factor of mixed infection differentiates Type C from Types A and B* and completely alters the prognosis, as well as the line of therapeutic attack. Roentgenologically, one can often detect this factor by the more conglomerate shadows in the stereoroentgenogram and by the tendency to cavity formation. The typical signs of tuberculosis may, at an early stage, be covered up by these massive shadows which have none of the characteristics which distinguish that disease roentgenologically in its more uncomplicated state. This fact may render the type under discussion a difficult one to differentiate from certain nontuberculous affections such as pneumonoconiosis or bronchiectasis; *but one can usually find some area in the lung field where the uncomplicated tuberculous process manifests itself.*

The writer believes that he has observed cases of *Type C* revert to *Type B* and proceed to symptomatic recovery after the enucleation of caseating tonsils. Probably the same thing occurs after the elimination of dental foci, when these are responsible for the secondary infection.

The explanation of the type under consideration is, so far as the writer knows, purely hypothetical. However, we, as roentgenologists, are more concerned with the fact that such a type exists with its characteristic roentgenological signs than we are with its etiological explanation. It is frequently possible to differentiate the type at a relatively early stage by means of the signs enumerated. And since the prognosis differs materially from that of the other types it is highly important that an attempt be made to do so.

While *Type D*, or healed tuberculosis, has no clinical significance, it is of roentgenological importance because its signs may be misinterpreted as those of active disease. When the observer is convinced that no active lesion is present, it is perhaps better to ignore these signs of healed disease, lest to them be attributed undue importance by the clinician. However, there is often a possibility that an active process may be partially covered up or rendered indistinct and atypical by the shadows of healed lesions, and then the question of activity must be left indeterminate. In the final analysis, in any event, clinical evidence will usually outweigh roentgenological evidence in the determi-

nation of the degree of activity of a known lesion.

The term "latent pulmonary tuberculosis" becomes obsolete under the present conception of the disease, because latency signifies inactivity and the only inactive lesion is a healed one. This term has frequently been applied to that form of tuberculosis herein described as *Type A*, but since this type of lesion is productive of symptoms and since there is abundant roentgen evidence that it is a progressive process, the term is patently misapplied.

It must be conceded that certain non-tuberculous conditions may produce changes in the lung fields which closely simulate those of tuberculosis—*Type A*. There are usually certain essential differences, however, which aid materially in the diagnosis. Thus there is not the same tendency to localization, the infiltrating process appearing more evenly distributed through the lung fields, chiefly along the bronchi, and only appearing in the periphery beyond the bronchi when involvement is very extensive. This is especially true of pneumonoconiosis. The lung changes due to chronic congestion of mitral stenosis have chiefly their diffuse distribution to distinguish them. The tuberculous lesion in its early active state offers less obstruction to the rays, and hence casts a shadow of less density than other chronic processes.

Concurrent with certain pyogenic infections of the lower lobes and pleura one may sometimes observe in the upper lobes the type of shadow seen early in tuberculosis. Since this is by no means a constant finding in empyema or lung abscess cases, the writer has been inclined to the view that in such instances the process is in fact a tuberculous one.

If the contention presented in this communication is sustained by future experience and study, it but reëmphasizes the necessity of close correlation of the efforts of roentgenologist and clinician. For the signs of tuberculosis found in the stereogram of the lungs increase in diagnostic value as they are supplemented and enriched by clinical signs and symptoms.

Finally, the writer wishes to acknowledge the helpful suggestions of Dr. E. T. Bell, of the Department of Pathology, University of Minnesota.

ROENTGEN RAY PROTECTIVE MATERIALS

BY W. S. GORTON, PH.D.

Associate Physicist, Bureau of Standards

WASHINGTON, D. C.

ADEQUATE protection from the *x*-rays is of increasing importance since the advent of the high-powered interrupterless *x*-ray machine and the Coolidge tube. By these means, *x*-rays of such intensity can be produced that protective devices which were previously suitable may not now give sufficient protection. In view of the proved harmfulness of undue exposure to the rays and of the possibility of the existence of effects, of which as yet we know nothing, the subject of *x*-ray protective materials deserves considerable attention.

When the study of these materials was initiated at the Bureau of Standards, one of the first steps taken was to ascertain the current practice concerning them. In addition, specimens were procured in the open market from most of the dealers in *x*-ray apparatus and supplies and samples obtained from various manufacturers. As a rule no quantitative statement as to composition, or protective power, of these materials could be obtained from dealers. Statements as to composition could generally be had from manufacturers when these were known. About the only information available from dealers were statements that the protective powers of this or that piece of material were "adequate."

It is obviously desirable that the purchaser have information which will enable him to decide to what extent the material furnished meets his requirements, and, further, to judge the relative merits of materials obtained from different sources. The important thing is the extent to which the piece of material used absorbs the *x*-rays incident upon it. The amount of such absorption depends upon the composition of the incident rays, and upon the amount and kind of the elements which compose the protective material. A knowledge of these last would enable the user to calculate the absorption of his particular piece of protective material, whenever detailed knowledge of the absorption of the elements composing it and the composition of the incident *x*-radiation became available. Practically all protective materials hitherto used owe their absorbing power almost entirely to the presence in them of lead. Consequently they should absorb *x*-rays of all kinds in a like manner with lead; and the absorbing power of any piece of such material should be practically equivalent to a certain thickness of lead.

The simplest method, then, of assigning a value to the absorbing power of a piece of protective material is to find the thickness of lead which will absorb *x*-rays to the same extent. This method, which has been somewhat widely used, has been studied in some detail at the Bureau of Standards. The procedure is simply to prepare a scale consisting of a series of different thicknesses of lead. This scale is placed side by side with the piece of protective material to be examined upon an *x*-ray plate, the plate being in the usual double envelope. An exposure of proper duration is made and the areas of equal density on the plate are then determined. A piece of material is said to be equivalent in protective power to a thickness of lead giving the same density of image; this thickness of lead is called the *equivalent thickness of lead* or briefly, the *lead equivalent* of the piece of material. Fig. 1 is reproduced from a representative plate made in the manner described.

While our knowledge of the absorption of *x*-rays by matter seemed to indicate that the protective material and its equivalent thickness of lead should absorb the incident beam of rays to the same extent,[1] still the matter was tested in several ways. The quality and intensity of the incident beam were changed by varying the parallel spark gap at which the tube was operating over the range from three to nine inches and by using filters of from 0 to 3 mm. of aluminum for each value of the spark gap. The value of the equivalent thickness of lead was unaffected by these changes, showing that material and lead transmitted the same amount of energy as measured photographically. It is, of course, possible that the two beams of *x*-rays simultaneously transmitted by the lead and by the material may affect the photographic plate to the same extent and

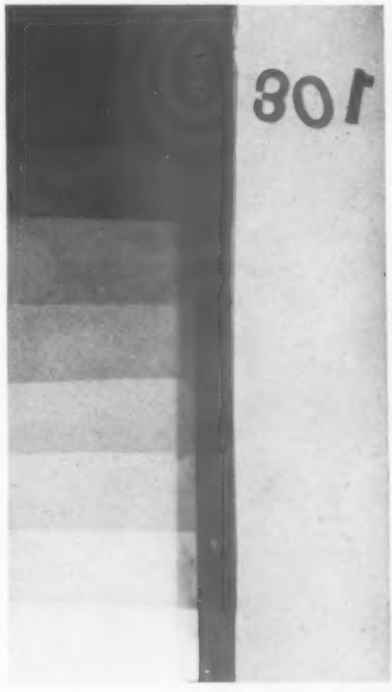


FIG. 1.

[1] This, of course, would not be true if the protective material depended upon any element other than lead for its effectiveness. No commercial protective material which does not depend upon lead for its opacity has come to the attention of the author.

nation of the degree of activity of a known lesion.

The term "latent pulmonary tuberculosis" becomes obsolete under the present conception of the disease, because latency signifies inactivity and the only inactive lesion is a healed one. This term has frequently been applied to that form of tuberculosis herein described as *Type A*, but since this type of lesion is productive of symptoms and since there is abundant roentgen evidence that it is a progressive process, the term is patently misapplied.

It must be conceded that certain non-tuberculous conditions may produce changes in the lung fields which closely simulate those of tuberculosis—*Type A*. There are usually certain essential differences, however, which aid materially in the diagnosis. Thus there is not the same tendency to localization, the infiltrating process appearing more evenly distributed through the lung fields, chiefly along the bronchi, and only appearing in the periphery beyond the bronchi when involvement is very extensive. This is especially true of pneumonoconiosis. The lung changes due to chronic congestion of mitral stenosis have chiefly their diffuse distribution to distinguish them. The tuberculous lesion in its early active state offers less obstruction to the rays, and hence casts a shadow of less density than other chronic processes.

Concurrent with certain pyogenic infections of the lower lobes and pleura one may sometimes observe in the upper lobes the type of shadow seen early in tuberculosis. Since this is by no means a constant finding in empyema or lung abscess cases, the writer has been inclined to the view that in such instances the process is in fact a tuberculous one.

If the contention presented in this communication is sustained by future experience and study, it but reëmphasizes the necessity of close correlation of the efforts of roentgenologist and clinician. For the signs of tuberculosis found in the stereogram of the lungs increase in diagnostic value as they are supplemented and enriched by clinical signs and symptoms.

Finally, the writer wishes to acknowledge the helpful suggestions of Dr. E. T. Bell, of the Department of Pathology, University of Minnesota.

ROENTGEN RAY PROTECTIVE MATERIALS

BY W. S. GORTON, PH.D.

Associate Physicist, Bureau of Standards

WASHINGTON, D. C.

ADEQUATE protection from the *x*-rays is of increasing importance since the advent of the high-powered interrupterless *x*-ray machine and the Coolidge tube. By these means, *x*-rays of such intensity can be produced that protective devices which were previously suitable may not now give sufficient protection. In view of the proved harmfulness of undue exposure to the rays and of the possibility of the existence of effects, of which as yet we know nothing, the subject of *x*-ray protective materials deserves considerable attention.

When the study of these materials was initiated at the Bureau of Standards, one of the first steps taken was to ascertain the current practice concerning them. In addition, specimens were procured in the open market from most of the dealers in *x*-ray apparatus and supplies and samples obtained from various manufacturers. As a rule no quantitative statement as to composition, or protective power, of these materials could be obtained from dealers. Statements as to composition could generally be had from manufacturers when these were known. About the only information available from dealers were statements that the protective powers of this or that piece of material were "adequate."

It is obviously desirable that the purchaser have information which will enable him to decide to what extent the material furnished meets his requirements, and, further, to judge the relative merits of materials obtained from different sources. The important thing is the extent to which the piece of material used absorbs the *x*-rays incident upon it. The amount of such absorption depends upon the composition of the incident rays, and upon the amount and kind of the elements which compose the protective material. A knowledge of these last would enable the user to calculate the absorption of his particular piece of protective material, whenever detailed knowledge of the absorption of the elements composing it and the composition of the incident *x*-radiation became available. Practically all protective materials hitherto used owe their absorbing power almost entirely to the presence in them of lead. Consequently they should absorb *x*-rays of all kinds in a like manner with lead; and the absorbing power of any piece of such material should be practically equivalent to a certain thickness of lead.

The simplest method, then, of assigning a value to the absorbing power of a piece of protective material is to find the thickness of lead which will absorb *x*-rays to the same extent. This method, which has been somewhat widely used, has been studied in some detail at the Bureau of Standards. The procedure is simply to prepare a scale consisting of a series of different thicknesses of lead. This scale is placed side by side with the piece of protective material to be examined upon an *x*-ray plate, the plate being in the usual double envelope. An exposure of proper duration is made and the areas of equal density on the plate are then determined. A piece of material is said to be equivalent in protective power to a thickness of lead giving the same density of image; this thickness of lead is called the *equivalent thickness of lead* or briefly, the *lead equivalent* of the piece of material. Fig. 1 is reproduced from a representative plate made in the manner described.

While our knowledge of the absorption of *x*-rays by matter seemed to indicate that the protective material and its equivalent thickness of lead should absorb the incident beam of rays to the same extent,[1] still the matter was tested in several ways. The quality and intensity of the incident beam were changed by varying the parallel spark gap at which the tube was operating over the range from three to nine inches and by using filters of from 0 to 3 mm. of aluminum for each value of the spark gap. The value of the equivalent thickness of lead was unaffected by these changes, showing that material and lead transmitted the same amount of energy as measured photographically. It is, of course, possible that the two beams of *x*-rays simultaneously transmitted by the lead and by the material may affect the photographic plate to the same extent and

FIG. 1.

[1] This, of course, would not be true if the protective material depended upon any element other than lead for its effectiveness. No commercial protective material which does not depend upon lead for its opacity has come to the attention of the author.

yet be different in quality and quantity. In this case, the use of a different detector for the rays should result in a different value for the equivalent thickness of lead. A fluorescent screen was used in place of the photographic plate but without appreciable effect upon the results. (It should be remarked in this connection that measurements made with the fluorescent screen are not quite as accurate as those made with the photographic plate; the principal reason for this is the feeble illumination of the screen due to the great absorption of the *x*-rays by the protective material.)

The possible presence of soft secondary radiation in different amounts from the lead and from the material was investigated for representative specimens of glass and rubber by placing an aluminum plate (1 mm. thick) between the photographic plate and the object being examined; no change due to its presence could be detected. The presence of extremely soft radiation which would be stopped by the usual double envelope surrounding the plate was investigated, for the same specimens, by placing the lead scale and the protective material in direct contact with the plate. When this was done with lead rubber no change in the apparent equivalent thickness of lead could be detected. With lead glass a decided change was noticed. The apparent equivalent thickness of lead was decreased—for some specimens by as much as 30 per cent. This effect is obviously due to soft radiation coming in greater amount from the glass than from the lead. This soft radiation was investigated by interposing layers of tissue paper between the plate and the protective material and scale. One layer caused a marked decrease in the density of the plate—the exposure, development, etc., remaining the same—but produced little effect on the apparent equivalent thickness of lead. Ten layers placed upon the plate would always cause the equivalent thickness of lead to resume its normal value, indicating the absorption of the larger part of this excess soft radiation by the thickness of tissue paper mentioned. Each sheet of this paper had a mass of 1.68 milligrams per square centimeter; its mineral content was insignificant as was shown by a direct comparison with an "ashless" filter paper, the two papers being placed side by side between the lead glass and the *x*-ray plate. This result was confirmed by a determination of the amount of ash of the paper in question. The thickness of air necessary to absorb this excess soft radiation can easily be calculated from the above data. As the elements in paper and air have not very different atomic weights we can, as a first approximation, assume that equal masses absorb equally. The thickness of air having the same mass as ten thicknesses of tissue paper is about 14 cm. under ordinary conditions.

The conclusions of the preceding paragraph apply only to the *difference* between the soft radiation given off by the protective material and that given off by the lead. Some idea of the amount and absorbability of this soft radiation from the lead glass alone (which gives off much more of it than does lead rubber) was obtained in the following way: A scale was prepared consisting of a series of different thicknesses of tissue paper from one to ten. This scale was placed between the lead glass and the *x*-ray plate, the scale being in immediate contact with both plate and glass, and an exposure of proper duration made. The first thickness of paper caused a marked decrease in the density of the plate. The successive decreases due to the immediately succeeding layers were marked, but each was less than the preceding one. After the seventh layer, the different layers could not be distinguished one from the other. A piece of stout cardboard, 1.5 mm. thick, placed below part of the tenth step of the scale caused a further decrease of density which could be detected but which was very small. From the above observations the conclusion is warranted that the ten thicknesses of tissue paper absorb practically all of the very soft secondary radiations from the representative specimens of protective material examined. The density

of the bare plate under the lead glass is very large while that under the ten thicknesses of tissue paper is comparatively small, consequently the amount of these very soft secondary radiations is very much larger (photographically measured) than the amount of the primary and penetrating secondary rays emerging from the glass. As the blackness of the plate under these conditions is due almost entirely to the soft secondary rays, a measurement (photographic) of their amount could easily be carried out if desired.

Deductions from the foregoing would indicate the wisdom of keeping any part of the body at least 15 cm. away from the usual protective materials, particularly glass, when there is nothing but air between the protective material and the body.

The effect, if any, of variations in exposure and development has not been investigated in a systematic manner. In the course of the work numerous specimens of protective materials have been examined on different days under different conditions of exposure and development, but the variation in results has been no greater than with several plates all of which have been given the same exposure and have been developed together. The variations that occur under these latter conditions are probably due to variations in the thickness of the sensitive film. It is well known that variations of as much as ten per cent. may occur in the thickness of the film, due to want of flatness in the glass.

The lead scales used in ascertaining the lead equivalents of protective materials had steps one centimeter wide. The difference in thickness from one step to the next was 0.1 mm. for total thicknesses in the neighborhood of 0.5 mm. For lesser thicknesses the difference in thickness from step to step was less than 0.1 mm., and for greater thicknesses the difference was greater than 0.1 mm. A large part of the specimens studied had equivalent thicknesses of lead in the neighborhood of 0.5 mm. The thickness of the various steps was measured with a micrometer caliper, and so could be determined to the hundredth part of a millimeter. The thickness of each step was constant to 0.01 mm. The lead used for the scales was commercial sheet lead, which is known to have a small percentage of impurities (less than one per cent.). The densities of several specimens of commercial sheet lead were determined. The greatest difference in density between any two of the specimens was one per cent.

The comparison of the density of image under the material with the density of image under the scale can be carried out in several ways. A very rough method is to view the plate as a whole. If this is done it is difficult to judge when equality of density has been reached, and errors of as much as one step, or even more, may be made, even with a properly exposed plate, unless great care is taken; at that, much experience is needed if reliable results are to be obtained.

A better method is to use a screen which has in it an opening just large enough to include one step of the scale and an equal area of the protective material. This would be sufficient were it not for the delicate nature of the thin lead scale which makes a support around its edges desirable. The image of this support on the plate causes the areas to be compared to be separated by a certain distance, which interferes with the accuracy of the comparison. With this method no errors of more than one-half step are likely, if due care be taken in making the observations.

In order to secure the best conditions the areas must be brought into contact in the field of view. To do this an optical device is necessary. The one used at the Bureau of Standards consists simply of two glass prisms, with their edges in contact, at a distance of a few centimeters from the plate. It has proved very satisfactory. With the use of a device such as this an entirely inexperienced observer has no trouble at all, with a properly

exposed plate, in deciding at once which step of the scale has the same density as the material being examined, or, as is generally the case, between which two steps of the scale the density lies. A little experience will enable the observer to say whether he considers the density to correspond to a thickness of lead half way between that of the two steps, whether it is nearer one step than the other, or whether it almost coincides with one of the steps. This procedure amounts to splitting the steps into six parts, and may seem hardly justifiable at first sight, but with a little experience observers seldom differ by more than one of the above-named parts. The numerical values to be assigned to these various judgments are somewhat arbitrary; those used in the present work were $\frac{1}{6}$, $\frac{1}{3}$, $\frac{1}{2}$, $\frac{2}{3}$, and $\frac{5}{6}$ of the difference from one step to the next. A representative series of measurements on a set of six plates all taken with the same piece of protective material follow:

Experienced observer

.45, .46, .47, .44, .46, .42 mean 0.450

Inexperienced observer

.50, .45, .47, .46, .47, .41 mean 0.460

It is seen that the maximum difference in the readings on any one plate is only 0.05 mm., which is 11 per cent. of the mean value. The mean values by the two observers differ by 0.01 mm. It will be noted that in the readings taken by an experienced observer the largest deviation from the mean amounted to somewhat less than 7 per cent. The probable error of the mean value in the particular series of observations given above is 1.1 per cent. and the probable error of any one observation is 2.7 per cent. For values of the equivalent thickness of lead slightly larger than those given in the above example the percentage error would be slightly less, and for smaller values would be slightly larger than that given above.

Various metals besides lead have been used to estimate the protection offered by *x*-ray protective materials. The use of such metals is not to be recommended, as the thickness of metal necessary to absorb the beam of *x*-rays to the same extent as does the protective material is not a constant but depends upon the quality of the beam. It is understood that aluminum has occasionally been used for estimating the protective power of protective materials. Aluminum, of course, is entirely unsuited for this purpose, if for no other reason than the great thickness necessary, which is roughly 100 times the equivalent thickness of lead.

It is convenient to have a name by which to designate the quality of a material as far as its protective power is concerned. The name "protective coefficient" has tentatively been selected to designate the ratio for any piece of material, of the equivalent thickness of lead to the thickness of the piece. This ratio is independent of the thickness of the material, and is approximately the percentage lead content *by thickness*.

The amount of lead contained in any piece of protective material can be estimated roughly by considering that it is given directly by the equivalent thickness of lead. A more accurate estimate is possible by using the following method: The equivalent thickness of lead is subtracted from the thickness of the material, the difference giving approximately the thickness occupied by the constituents of the material other than the lead. The assumption is made that the absorption of these residual constituents is the same as that of an equal thickness of ordinary glass or rubber as the case may be. The equivalent thickness of lead for this thickness of ordinary glass or rubber is subtracted from the equivalent thickness of lead for the piece, the difference giving the thickness of a sheet of lead having the same amount of lead per square centimeter as the protective material[2]. The table following gives the percentage lead content for various materials as determined by the latter

[2] It has come to the attention of the Bureau of Standards that in at least one case, it was assumed that a sheet of lead glass would give the same protection as a sheet of lead having the same area and weight. This amounts to assuming that the lead glass is *composed entirely* of lead, which is, of course, not by any means true.

method and as given by the manufacturers. The difference in the results obtained by the two above-outlined methods does not exceed eight per cent for lead glass, having a protective coefficient of ten per cent. For better lead glass and for practically all lead rubber the difference is less than this.

Material	Percentage by weight, of lead, mfr.	Percentage by weight, of lead, B.S.	Remarks
Glass	30	35	
"	20+7%Ba	35	Commercial *x*-ray protective glass.
"	42	40	
"	42	42	Improved protective plate glass.
"	74	70	Experimental lead glasses of irregular thickness.
"	74	67	
"	71	70	
"	71	58	
"	46	49	Improved lead plate glass.
"	54	55	Improved tube shield.
Rubber	78	78	Commercial lead rubber.
"	77	77	
"	77	74	
"	85	85	Experimental lead rubber.
"	83	88	
"	91	94	
"	85	84	

At the beginning of the present investigation 12 pieces of lead glass were purchased in the open market from representative dealers. The range of equivalent thickness of lead for these pieces was from 0.70 to 0.30 mm. The protective coefficient of all but two of the glasses ranged from 9 per cent. to 11. per cent., the average value being 10 per cent. Two pieces were found to offer no more protection than ordinary plate glass. The protective coefficient of these pieces was 0.9 per cent. and the equivalent thickness of lead 0.05 mm. Samples of lead rubber were received from various manufacturers and dealers. The protective coefficients of these materials ranged from 19 to 32 per cent., the average being 23 per cent.

Any desired protection from the *x*-rays can, of course, be obtained simply by increasing the thickness of protective material employed. This, however, is objectionable from many standpoints. The desirable method is to obtain the increased protection by increasing the lead content, and consequently, the protective coefficient, of the material. In view of the importance of the matter, the Bureau of Standards corresponded with various manufacturers in the endeavor to have them experiment with the object of producing improved materials. The manufacturers coöperated in a most gratifying manner and great improvements were made. Lead plate glass of satisfactory optical quality was made having a protective coefficient of 18 per cent., which is an 80 per cent. increase over the previous average value of 10 per cent. Lead rubber was made having a protective coefficient of 48 per cent., an increase of more than 100 per cent. over the previous average value of 23 per cent. The actual lead content of the glass and rubber mentioned was 49 and 94 per cent. respectively, as determined by the method of the present article, and 46 and 91 per cent. respectively, as given by the manufacturers.

Some of the improved varieties of lead rubber are as flexible as any of the kinds of commercial *x*-ray rubber hitherto obtainable; it is probable that protective garments of increased protective power can be made from these materials.

In the case of nearly all of the protective materials which have been tested at the Bureau of Standards, measurements of the density have been made. In the case of materials of regular shape this was done by measuring the dimensions and weighing; the density of pieces of irregular shape was determined by weighing in water. A simple,

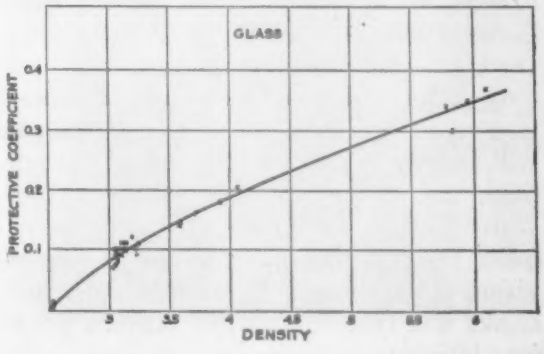


FIG. 2.

approximately linear, relation was found to exist between the density and the protective coefficient. The results are shown in Figs. 2 and 3.

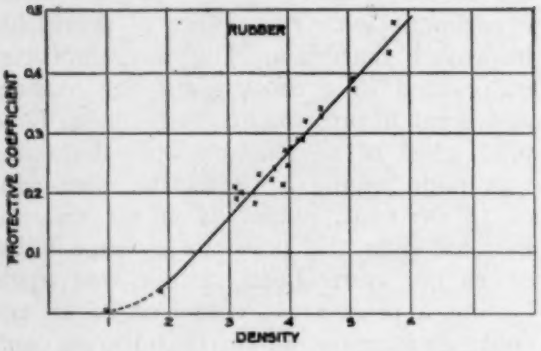


FIG. 3.

The results of the work may be summarized as follows:

1. The method of testing *x*-ray protective materials by comparing them with sheet lead has been investigated. It has been shown that, for all the materials examined, it is possible to find a certain thickness of lead which will have closely the same effect on a beam of *x*-rays of the sort used in practice as will the material itself, and that, consequently, the material may be said to have the same protective power as the thickness of lead mentioned; this thickness of lead has been called the "equivalent thickness of lead" for the piece of material in question.

2. A representative assortment of the *x*-ray protective materials on the market in 1917 has been examined.

3. Considerable improvements in protective materials have been made, at the suggestion of the Bureau of Standards, by several manufacturers of such materials.

Acknowledgment is due to the Corning Glass Works, Pittsburgh Plate Glass Co., The B. F. Goodrich Co., Manhattan Rubber Mfg. Co., and Price Electric Co. for their hearty coöperation in this investigation.

COMMUNICATION FROM THE WAR INDUSTRIES BOARD

UTILIZATION OF PLATINUM IN UNUSED INSTRUMENTS

1. In view of the limited supply of platinum in the country and of the urgent demand for war purposes, it is requested that every doctor and dentist in the country go carefully over his instruments and pick out EVERY SCRAP OF PLATINUM that is not absolutely essential to his work. These scraps, however small and in whatever condition, should reach Governmental sources without delay, through one of two channels:

(a) They can be given to proper accredited representatives of the Red Cross who will shortly make a canvass for that purpose.

(b) They may be sold to the Government through any bank under the supervision of the Federal Reserve Board. Such banks will receive and pay current prices for platinum.

By giving this immediate attention you will definitely aid in the war program.

2. It is recognized that certain dental and surgical instruments requiring platinum are necessary, and from time to time platinum is released for that purpose. It is hoped, however, that every physician and every dentist will use substitutes for platinum for such purposes wherever possible.

3. YOU ARE WARNED against giving your scrap platinum to any one who calls at your office without full assurance that that individual is authorized to represent the Red Cross in the matter.

(Signed) F. F. SIMPSON,

Lieutenant Colonel, M.C., N.A.,

Chief of Section of Medical Industry.

PULMONARY METASTASIS*

BY A. W. CRANE, M.D.

KALAMAZOO, MICH.

ONE of the substantial contributions of roentgenology to clinical medicine is the ready diagnosis of pulmonary metastasis in malignant disease. In pre-roentgen days carcinoma or sarcoma of the lungs was reported almost exclusively from post-mortem findings. The diagnosis could rarely be final in the absence of an autopsy, and the frequency of pulmonary invasion was a matter of statistical conjecture. But now the diagnosis can be made at an early stage by the *x*-ray plate with a precision unexcelled by the roentgen diagnosis of any other pulmonary lesion.

The detection of a pulmonary metastasis is of decisive surgical importance. The question of the nature of the primary lesion, the question of operability and the question of prognosis are thus settled. For this reason the *x*-ray examination of the lungs has been established as a routine in some surgical clinics in cases of suspected malignancy anywhere in the body.

One avenue of the invasion of the lungs is from the upper peritoneal cavity through the central tendon of the diaphragm into the mediastinum and thence to the pulmonary fields. This is a lymphatic route, which was beautifully demonstrated by Clark [1] in 1901 in its relation to pulmonary infection following abdominal sepsis. It is one explanation of postoperative pneumonitis and is the chief reason for the Fowler's position after laparotomy, whereby the mediastinal lymph current could be retarded. The lymphatic drainage, therefore, from the upper abdomen is into the mediastinal system, precisely as the drainage from the arm is into the axillary and from the leg into the inguinal glands.

It would be a matter of logical sequence for the diagnostician to examine the mediastinal glands for signs of upper abdominal metastasis, just as he examines the glands of the rectal shelf for signs of lower abdominal metastasis. But the mediastinum is accessible only to the *x*-ray. The differentiation of an inflammatory adenopathy from a sarcomatous invasion, when confined to the mediastinum, offers some difficulties, but the unhesitating extension of a carcinomatous invasion throughout both lungs simultaneously furnishes pathognomonic signs on the *x*-ray plate. Thus a case of suspected carcinoma of the liver without pulmonary symptoms may nevertheless show marked pulmonary metastasis. For example, Mrs. W—had a clear-cut history, extending back many years, of gall-stone colics with deep jaundice. A tumor could be palpated in the region of the gall-bladder. A routine screen inspection followed by a stereo-set of the chest re-

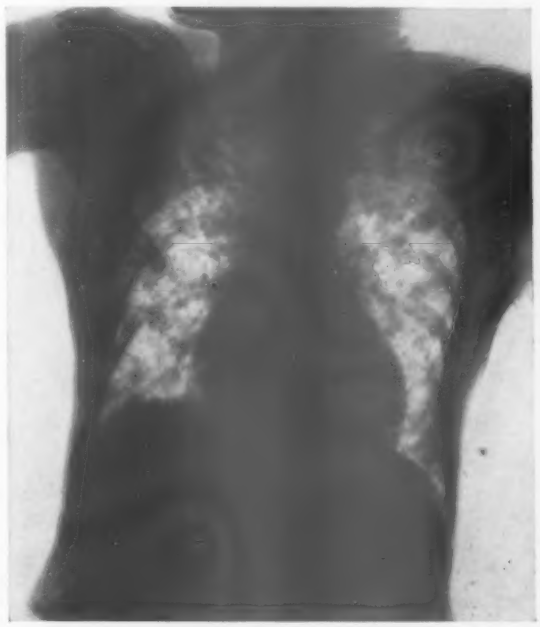


FIG. 1. CARCINOMA OF BOTH LUNGS SECONDARY TO CARCINOMA OF THE LIVER.

[1] Elimination of Peritoneal Infection and Preventions of Surgical Peritonitis. *Jour. A.M.A.* 1901, vol. xxxvii, page 360.

* Read at the Mid-Winter Session of Western Roentgenologists, Toledo, O., February 22, 1918.

FIG. 2. CARCINOMA OF BOTH LUNGS SECONDARY TO CARCINOMA OF THE RIGHT BREAST.

vealed an evenly distributed carcinomatous invasion of both lungs (Fig. 1) although no pulmonary symptoms were present. Without the roentgen study of the chest the gallstones might have been removed without satisfaction to patient, family, surgeon or diagnostician.

Metastasis of the lungs following mammary carcinoma shows a generalized pulmonary invasion indistinguishable from a metastatic extension from the liver (Fig. 2). There is here a suggestion a little short only of a demonstration that the pulmonary invasion proceeds, not by direct extension through the chest wall, but by a circuitous route whereby the carcinoma reaches the lymph channels which drain into the mediastinum. The later day practice of surgeons in following down the muscle sheaths from the mamma to the abdominal parietes is a confirmation of this hypothesis.

Parallel to pulmonary metastasis is the extension of abdominal tuberculosis via the mediastinum into the lungs. This is beautifully illustrated by the pericarditic pseudocirrhosis of the liver of Pick (Fig. 3) in which case tuberculosis extends from the liver into the mediastinum and thence throughout both lungs exactly as does

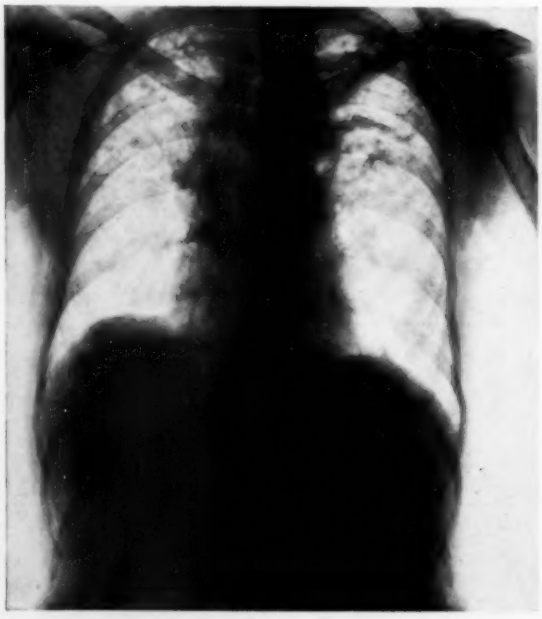


FIG. 3. ADHERENT PERICARDIUM, MEDIASTINITIS AND PULMONARY TUBERCULOSIS. CHEST IN A CASE OF PERICARDITIC PSEUDOCIRRHOSIS OF THE LIVER OF PICK SHOWING CLINICALLY MARKED ŒDEMA OF LEGS AND FEET WITH ASCITES. THE SCANTY SPUTUM WAS LOADED WITH TUBERCLE BACILLI.

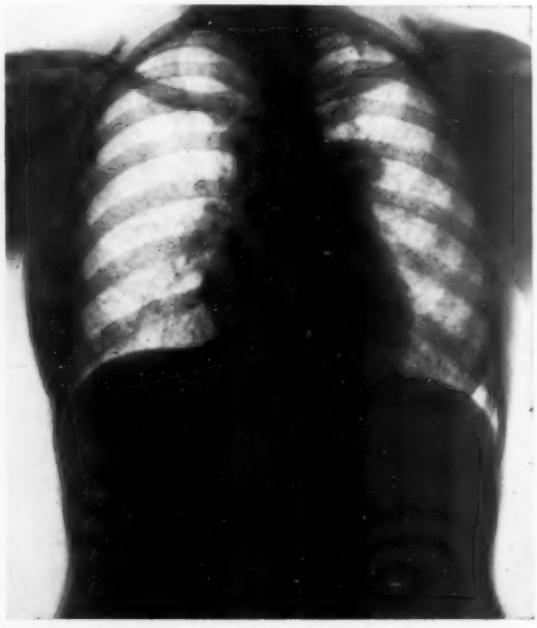


FIG. 4. PULMONARY TUBERCULOSIS FOLLOWING TUBERCULOSIS OF THE PERITONEUM. COUGH AND SPUTUM CAME LATE IN THE CASE. TUBERCLE BACILLI WERE FINALLY FOUND IN ABUNDANCE.

carcinoma. In Pick's disease, however, we have a distinctive sign in adherent pericardium, although other intrinsic characters make differentiation positive. Such

FIG. 5. CARCINOMA OF SACRUM AND SPINE SECONDARY TO CARCINOMA OF THE PROSTATE. CALCIUM HAS BEEN DISSOLVED OUT OF PORTIONS OF BONE TO BE REDEPOSITED IN OTHER PORTIONS OF THE SKELETON AND ALSO IN THE LUNG. BONE STRUCTURE HAS BEEN LARGELY OBLITERATED.

cases may consistently be termed tuberculous metastasis.

Pick's disease with its peculiarities is believed to be due to the avian type of the tubercle bacillus, but mediastinal infection with extension to the lungs is also true in ordinary peritoneal tuberculosis (Fig. 4). In such patients cough and expectoration are late symptoms and the *x*-ray may give the first definite sign of the involvement. This is one of many reasons why an examination of the chest should never be omitted in abdominal cases.

There is a third form of pulmonary metastasis which is rare but nevertheless of real importance in roentgenology. This is the "calcium metastasis" of Virchow. In malignant disease of bones whether metastatic or primary and in other bone diseases with disturbed calcium metabolism, calcium salts may be dissolved out to be redeposited in distant tissues. This process of redeposition may take place in the lungs to a greater or less extent, sometimes to an extreme extent. At autopsy the lungs may be found of a stiff woody texture owing to the thorough infiltration by calcium. Such lungs are not the subject of either malignant or bacterial disease, and while the process is known as a "calcium metastasis" it is obviously not a secondary transplantation of a disease. The importance of the condition in roentgen diagnostics lies in ready detection of calcium deposits in lung tissue and in the indication of serious bone disease somewhere in the body.

In one case of pulmonary calcium metastasis illustrated in this paper the bone disease was metastatic, the primary affection being a carcinoma of the prostate, so that the lung conditions were the third remove. The patient had a cough with a scanty expectoration which was intermittently blood stained but contained no tubercle

FIG. 6. PULMONARY CALCIUM METASTASIS SECONDARY TO CARCINOMA OF BONE IN A CASE OF CARCINOMA OF THE PROSTATE. THE CALCIUM IN THE LUNG TISSUE IS IN THE FORM OF A FLAKY DISSEMINATION.

bacilli. He also complained of pain in the small of the back and down both legs. He had been troubled with an enlarged prostate for a number of years and the

FIG. 7. PULMONARY CALCIUM METASTASIS SECONDARY TO SYPHILIS WHICH PRESUMABLY AFFECTED SOME PORTION OF THE SKELETON. THE STEREOSCOPIC PLATES SHOW A FLAKY DISSEMINATION OF THE CALCIUM THROUGHOUT BOTH LUNGS. THE DISTRIBUTION IS SYMMETRICAL WITH RELATION TO THE HILUM ON EACH SIDE. NO PULMONARY SYMPTOMS OF ANY KIND WERE PRESENT.

catheter had become a necessity. The digital examination of the prostate showed an irregular enlargement suggestive of malignancy. A plate was made of the sacrolumbar region for signs of metastasis (Fig. 5). The bones were honeycombed and the normal osseous structure largely destroyed. A screen inspection of the lungs showed extensive changes and a plate was made (Fig. 6). A study of this plate showed a flaky calcium infiltration generalized in both lungs. The distinctive signs of pulmonary carcinoma were absent and the case was considered one of "calcium metastasis." Another case (Fig. 7) is still more distinctive but was not associated with carcinoma. A four-plus Wassermann was present and a bone involvement was probable although not demonstrated.

A consideration of lung metastasis emphasizes the fact that the diaphragm is merely an anatomic separation of the two great cavities of the body and that the chest can rarely be ignored no matter where the disease may be located.

Another corollary lies in the interpretation of the hilus shadows upon plates of the chest. These are usually considered to be the result of drainage from lungs and bronchi, but it is evident that the line of demarcation between a mediastinal and a hilus adenopathy, even upon stereoscopic plates, is impossible. An anatomic separation and distinction of the lymph channels seem at present equally impossible; so that the usual interpretation of the hilus clusters, without a consideration of previous abdominal infections, needs revision.

Furthermore the presence of calcified foci in the hilus or pulmonary areas is not to be taken as unequivocal evidence of a healed tubercular process. Calcium may be deposited in any necrotic bit of tissue. An old, inclosed bloodclot may become calcified. The calcified focus anywhere in the body, the lungs not excepted, in about 30 per cent. of cases, goes on to actual ossification. Disturbed calcium metabolism results, as we have seen, in the redeposition of calcium in lung tissue. Thus it is apparent that in roentgenology as in the medicine of Hippocratic times, "Experience is fallacious and judgment difficult."

ENGLISH—FRENCH GLOSSARY OF ROENTGEN RAY TERMS*

ANATOMY	ANATOMIE
1. Head	La tête.
2. Eye	L'œil, *m.*
3. Nose	Le nez.
4. Ear	L'oreille, *f.*
5. Mouth	La bouche.
6. Tongue	La langue.
7. Tooth	La dent.
8. Lip	La lèvre.
9. Scalp	Le cuir chevelu.
10. Skull	Le crâne.
11. Brain	Le cerveau.
12. Forehead	Le front.
13. Face	La face.
14. Cheek	La joue.
15. Nostril	La narine.
16. Jaw	La mâchoire.
17. Chin	Le menton.
18. Orbit	L'orbite, *f.*
19. Pupil	La pupille.
20. Cornea	La cornée.
21. Hair	Les cheveux.
22. Moustache	La moustache.
23. Beard	La barbe.
24. Mastoid	La mastoïde.
25. Neck	Le cou.
26. Throat	La gorge.
27. Larynx	Le larynx.
28. Trachea	La trachée.
29. Bronchus	La bronche.
30. Lung	Le poumon.
31. Pleura	La plèvre.
32. Diaphragm	Le diaphragme.
33. Chest	La poitrine.
34. Heart	Le cœur.
35. Pericardium	Le péricarde.
36. Aorta	L'aorte, *f.*
37. Blood	Le sang.
38. Artery	L'artère, *f.*
39. Vein	La veine.
40. Blood-vessel	Le vaisseau (sanguin).
41. Pharynx	Le pharynx.
42. Œsophagus	L'œsophage, *m.*
43. Cardia	Le cardia.
44. Stomach	L'estomac, *m.*
45. Pylorus	Le pylore.
46. Duodenal cap	Le bulbe duodénal.
47. Duodenum	Le duodénum.
48. Intestines	L'intestin, *m.*
49. Appendix	L'appendice, *m.*
50. Colon	Le côlon.
51. Rectum	Le rectum.
52. Abdomen	L'abdomen, *m.*
53. Liver	Le foie.
54. Gallbladder	La vésicule biliaire.
55. Spleen	La rate.
56. Kidney	Le rein.
57. Ureter	L'uretère, *m.*
58. Bladder	La vessie.
59. Rib	La côte.
60. Sternum	Le sternum.
61. Clavicle	La clavicule.
62. Shoulder	L'épaule, *f.*
63. Scapula	L'omoplate, *f.*
64. Arm	Le bras.
65. Elbow	Le coude.
66. Fore-arm	L'avant-bras, *m.*
67. Wrist	Le poignet.
68. Hand	La main.
69. Finger	Le doigt.
70. Thumb	Le pouce.
71. Humerus	L'humérus, *m.*
72. Radius	Le radius.
73. Ulna	Le cubitus.
74. Back	Le dos.
75. Spinal column	La colonne vertébrale.
76. Vertebra	La vertèbre.
77. Pelvis	Le bassin.
78. Hip	La hanche.
79. Thigh	La cuisse.
80. Femur	Le fémur.
81. Knee	Le genou.
82. Patella	La rotule.
83. Leg	La jambe.
84. Calf	Le mollet.
85. Ankle	La cheville.
86. Heel	Le talon.
87. Toe	L'orteil, *m.*
88. Tibia	Le tibia.
89. Fibula	Le péroné.
90. Bone	L'os, *m.*
91. Joint	L'articulation, *f.*
92. Muscle	Le muscle.
93. Tendon	Le tendon.
94. Fascia	L'aponévrose, *f.*
95. Nerve	Le nerf.
96. Skin	La peau.
97. Axilla	L'aisselle, *f.*
98. Groin	L'aine, *f.*
99. Buttock	La fesse.
100. Foot	Le pied.
101. Scaphoid	Le scaphoïde.
102. Semi-lunar	Le semi-lunaire.
103. Cuneiform	Le pyramidal.
104. Pisiform	Le pisiforme.
105. Trapezium	Le trapèze.
106. Trapezoid	Le trapézoïde.
107. Magnum	Le grand os.
108. Unciform	L'os crochu, *m.*
109. Palm	La paume.
110. Astragulus	L'astragale, *f.*
111. Calcis	Le calcanéum.
112. Cuboid	Le cuboïde.
113. Internal cuneiform.	Le premier cunéiforme.
114. Middle cuneiform.	Le deuxième cunéiforme.
115. External cuneiform.	Le troisième cunéiforme.
116. Instep	L'avant-pied, *m.*
117. Sole	La plante (du pied).

PATHOLOGY	PATHOLOGIE
1. Projectile	Le projectile.
2. Foreign body	Le corps étranger.
3. Fracture	La fracture.
4. Dislocation	La subluxation.
5. Subluxation	La luxation.
6. Fragment	Le fragment.
7. Metallic dust	Les poussières métalliques.
8. Impaction	L'engrènement, *m.*
9. Periosteitis	La périostite.
10. Osteomyelitis	L'ostéomyélite, *f.*
11. Callus	Le cal.
12. Decalcification	La décalcification.
13. Sequestrum	Le séquestre.

* See "Instruction of War Roentgenologists," by R. Ledoux-Lebard, page 453.

PATHOLOGY	PATHOLOGIE
14. Gangrene	La gangrène.
15. Ankylosis	L'ankylose, *f.*
16. Exostosis	L'exostose, *f.*
17. Tumor	La tumeur.
18. Cyst	Le kyste.
19. Displacement	Le déplacement.
20. Metastasis	La métastase.
21. Abscess	L'abcès, *m.*
22. Sclerosis	La sclérose.
23. Infiltration	L'infiltration, *f.*
24. Solidification	La solidification.
25. Cavity	La cavité.
26. Fluid	Le liquide.
27. Pus	Le pus.
28. Effusion	L'épanchement, *m.*
29. Pleurisy	La pleurésie.
30. Pneumonia	La pneumonie.
31. Adhesion	L'adhérence, *f.*
32. Empyema	L'empyème, *m.*
33. Pneumothorax	Lepneumothorax.
34. Dilatation	La dilatation.
35. Aneurism	L'anévrysme, *m.*
36. Diverticulum	Le diverticule.
37. Ulcer	L'ulcère, *m.*
38. Incisura	L'échancrure, *f.*
39. Perforation	La perforation.
40. Penetration	La pénétration.
41. Hour-glass	Le sablier.
42. Biloculation	La biloculation.
43. Gall-stones	Les calculs biliaires.
44. Obstruction	L'obstruction, *f.*
45. Peristalsis	Le péristaltisme.
46. Retention	La rétention.
47. Residue	Le résidu.
48. Motility	La motilité.
49. Appendicitis	L'appendicite, *f.*
50. Calculus	Le calcul.
51. Calcified gland	Le ganglion calcifié.
52. Arthritis	L'arthrite, *f.*
53. Strain	L'entorse, *f.*
54. Splint	La gouttière.
55. Bandage	La bande.
56. Plaster cast	Le plâtre.
57. Drain	Le drain.
58. Fistula	La fistule.
59. Tuberculosis	La tuberculose.
60. Acute	Aigu.
61. Chronic	Chronique.
62. Active	Actif.
63. Inactive process	Le processus éteint.
64. Cancer	Le cancer.

PHYSICS	PHYSIQUE
1. Electricity	L'électricité, *f.*
2. Positive rays	Les rayons positifs.
3. Cathode rays	Les rayons cathodiques.
4. X-rays	Les rayons X.
5. Secondary rays	Les rayons secondaires.
6. Normal ray	Le rayon normal.
7. Volt	Le volt.
8. Kilovolt	Le kilovolt.
9. Ampere	L'ampère, *m.*
10. Milliampere	Le milliampère.
11. Ohm	L'ohm, *m.*
12. Watt	Le watt.
13. Kilowatt	Le kilowatt.
14. Electro-motive force.	La force électro-motrice.
15. Current	Le courant.

PHYSICS	PHYSIQUE
16. Direct current	Le courant continu.
17. Alternating current	Le courant alternatif.
18. Resistance	La résistance.
19. Polarity	La polarité.
20. Positive pole	Le pôle positif.
21. Negative pole	Le pôle négatif.
22. Alternation	L'alternance, *f.*
23. Spark	L'étincelle, *f.*
24. Spark gap	L'étincelle équivalente.
25. Inverse	L'inverse, *m.*
26. Induction	L'induction, *f.*
27. Shunt	En dérivation.
28. Arc	L'arc, *m.*
29. Vacuum	Le vide.
30. Velocity	La vitesse.
31. Ground-wire	Le fil de terre.
32. Series connection	La connexion en série.
33. Parallel connection	La connexion en parallèle.
34. Phase	La phase.
35. "Step-up"	L'élévateur de tension, *m.*
36. "Step-down"	L'abaisseur de tension, *m.*
37. Frequency	La fréquence.
38. Electron	L'électron, *m.*
39. Circuit	Le circuit.
40. Make. To (circuit).	Fermer. (Le
41. Break. To (circuit).	Ouvrir. circuit.)
42. Revolution	Le tour.
43. Terminal	La borne.
44. Size	La dimension.
45. Shape	La forme.
46. Position	La position.
47. Angle	L'angle, *m.*
48. Weight	Le poids.
49. Length	La longueur.
50. Width	La largeur.
51. Thickness	L'épaisseur, *f.*
52. Density	La densité
53. Atomic weight	Le poids atomique.
54. Distance	La distance.
55. Color	La couleur.
56. Depth	La profondeur.
57. Radiation	La radiation.
58. Absorption	L'absorption, *f.*
59. Time	Le temps.
60. Exposure	L'exposition, *f.*
61. Reduction	La réduction.
62. Metal	Le métal.
63. Coal gas	Le gaz d'éclairage.
64. Ether vapor	La vapeur d'éther.
65. Alcohol vapor	La vapeur d'alcool.
66. Mercury	Le mercure.
67. Lead	Le plomb
68. Copper	Le cuivre.
69. Iron	Le fer.
70. Steel	L'acier, *m.*
71. Aluminium	L'aluminium, *m.*
72. Tin	L'étain, *m.*
73. Brass	La laiton.
74. Vertical	Vertical, e.
75. Horizontal	Horizontal, e.
76. Oblique	Oblique.
77. Round	Rond, e.
78. Square	Carré, e.
79. Circle	Le cercle.
80. Black	Noir, e.
81. White	Blanc, he.
82. Violet	Violet, te.
83. Indigo	Indigo.
84. Blue	Bleu, e.

PHYSICS	PHYSIQUE
85. Green	Vert, e.
86. Yellow	Jaune.
87. Orange	Orangé, e.
88. Red	Rouge.
89. Fluorescence	La fluorescence.

PHOTOGRAPHY	PHOTOGRAPHIE
1. Plate	La plaque; le cliché.
2. Film	Le film.
3. Tank	La cuve.
4. Tray	La cuvette.
5. Developer	Le révélateur.
6. Fixer	Le fixateur.
7. Reducer	L'affaiblisseur.
8. Intensifier	Le renforçateur.
9. Dark-room	La chambre noire.
10. Red lamp	La lanterne rouge.
11. Paper	Le papier.
12. Print	Le positif.
13. Envelope	L'enveloppe, *f.*
14. Box	La boite.
15. Lead box	La boite plombée.

APPARATUS	APPAREILLAGE
1. Transformer	Le transformateur.
2. Induction coil	La bobine.
3. Table	La table.
4. Tube	Le tube.
5. Valve tube	La soupape.
6. Rheostat	Le rhéostat.
7. Switch	Le coupe-circuit.
8. Time switch	Le relais à temps.
9. Fuses	Les plombs (fusibles).
10. Wire	Le fil.
11. Interrupter	L'interrupteur, *m.*
12. Foot-switch	La commande à pédale.
13. Milliammeter	Le milliampèremètre.
14. Level	Le niveau.
15. Screen	L'écran, *m.*
fluorescent	fluorescent.
reinforcing	renforçateur.
16. Diaphragm	Le diaphragme.
17. Pulley	La poulie.
18. Counterweight	Le contrepoids.
19. Cone	Le limitateur.
20. Tube-shield	La cupule.
21. Tube-holder	L'étrier, *m.*
22. Tube-stand	Le pied.
23. Filament	Le filament.
24. Sand-bag	Le sac de sable.
25. Plate-holder	Le châssis.
26. Armature	L'armature, *f.*
27. Gloves	Les gants.
28. Apron	Le tablier.
29. Glasses	Les lunettes.
30. Binding-post	L'antenne, *m.*
31. Condenser	Le condensateur.
32. Nail	Le clou.
33. Screw	La vis.
34. Nut	L'écrou, *m.*
35. Bolt	Le boulon.
36. Insolation	L'isolement, *m.*
37. Reel	L'enrouleur, *m.*
38. Clock	L'horloge, *f.*
39. Watch	La montre.

APPARATUS	APPAREILLAGE
40. Instrument	L'instrument, *m.*
41. Trolley	Le trolley.
42. Stool	Le tabouret.
43. Chair	La chaise.
44. Tool	L'outil, *m.*
45. Screwdriver	Le tournevis.
46. Pliers	La pince.
47. Needle	L'aiguille, *f.*
48. Casette	Le châssis porteécran.
49. Illuminating box	Le négatoscope.
50. Ink	L'encre, *f.*
51. Tattoo ink	L'encre à tatouer.
52. Handle	La poignée.
53. Flame	La flamme.
54. Regulator	Le régulateur.
55. Floor	Le plancher.
56. Wall	Le mur.
57. Ceiling	Le plafond.
58. Knife	Le bistouri.
59. Scissors	Les ciseaux, *m.*
60. Forceps	La pince.
61. Pointer	L'aiguille indicatrice, *f.*
62. Magnet	L'aimant, *m.*
63. Compress	La compresse.
64. Towell	La serviette.
65. Cloth	Le champ.
66. Blanket	Le drap.
67. Pillow	L'oreiller, *m.*

PHRASES	PHRASES
1. Will you?	Voulez-vous?
2. Please	S'il vous plait.
3. Hold your breath	Ne respirez plus.
4. Breathe quietly	Respirez doucement.
5. Take a deep breath.	Respirez fort.
6. Cough	Toussez.
7. Hold perfectly still	Ne bougez plus.
8. Turn around	Tournez-vous.
9. Move to the right	Allez à droite.
10. Move to the left	Allez à gauche.
11. Get on the table	Montez sur la table.
12. Lie on your back	Couchez-vous sur le dos.
13. Lie on your stomach.	Couchez-vous sur le ventre.
14. Lie on your right side	Couchez-vous sur le côté droit.
15. Lie on your left side.	Couchez-vous sur le côté gauche.
16. Turn over	Retournez-vous.
17. Move toward the head of the table	Remontez plus haut sur la table.
18. Move toward the foot of the table	Descendez plus bas sur la table.
19. Bend your elbow	Pliez le coude.
20. Bend your knee	Pliez le genou.
21. Turn your hand over	Tournez la main.
22. Open your mouth	Ouvrez la bouche.
23. Close your mouth	Fermez la bouche.
24. Draw in the abdomen	Rentrez le ventre.
25. Fill out the abdomen.	Gonflez le ventre.
26. Relax	Laissez-vous aller.
27. Where are you hurt?	Où êtes-vous blessé?
28. Is it very painful?	Souffrez-vous beaucoup?
29. Do I hurt you?	Est-ce que je vous fais mal?

PHRASES	PHRASES
30. What wounded you?.	Par quoi avez-vous été blessé?
31. Have you had an X-ray examination?	Avez-vous déjà passé aux rayons X?
32. How many times?..	Combien de fois?
33. It is a bullet.....	C'est une balle.
34. It is shrapnel.....	C'est une balle de shrapnel.
35. It is a shell-fragment	C'est un éclad d'obus.
36. When were you wounded?	Quand avez-vous été blessé?
37. Do not be afraid...	N'ayez pas peur.
38. I will not hurt you..	Je ne vous ferai pas de mal.
39. Drink this.....	Buvez ceci.
40. When I tell you.....	Quand je vous le dirai.
41. Hold the glass in your left hand...	Prenez le verre dans la main gauche.
42. Turn off the light..	Éteignez.
43. Turn on the light..	Allumez.
44. A little more current.	Un peu plus de courant.
45. A little less current.	Un peu moins de courant.
46. More penetration....	Plus dur.
47. Less penetration....	Moins dur.
48. The tube is too hard.	Le tube est trop dur.
49. The tube is too soft.	Le tube est trop mou.
50. Shut the door.....	Fermez la porte.
51. Toward you.....	Vers vous.
52. Toward me.....	Vers moi.
53. To your right.....	A votre droite.
54. To your left.....	A votre gauche.
55. You are just right...	Vous y êtes.
56. This is the nearest point	C'est le point le plus proche.
57. There are several fragments	Il y a plusieurs fragments.
58. There is some metallic dust.....	Il y a des poussières métalliques.
59. It is smooth.....	Il est lisse.
60. It is irregular.....	Il est irrégulier.
61. Do you see it?.....	Le voyez-vous?
62. How long have you been ill?	Depuis combien de temps êtes-vous malade?
63. Take off your clothes	Déshabillez-vous.
64. Put on your clothes	Rhabillez-vous.
65. Sit down	Asseyez-vous.
66. Stand up	Levez-vous.

PERSONEL	LE PERSONNEL
1. Patient	Le malade.
2. Wounded patient ...	Le blessé.
3. Soldier	Le soldat.
4. Officer	L'officier, *m.*
5. Litter-bearer	Le brancardier.
6. Anæsthetist	L'anesthésiste, *m.*
7. Surgeon	Le chirurgien.
8. Assistant	L'aide, *m.*
9. Nurse	
male.....	L'infirmier, *m.*
female.....	L'infirmière, *f.*
10. Sister	La sœur.
11. Technician	Le manipulateur.
12. Radiologist	Le radiologiste.
13. Photographer	Le photographe.
14. Electrician	L'électricien, *m.*
15. Stenographer	La dactylographe.
16. Orderly	L'ordonnance, *m.*

WEIGHTS AND MEASURES	POIDS ET MESURES
1 Grain (Av.)	64,8 milligrammes.
15.4324 Grains	1 gramme.
1 Pound	0,453592 kilogramme.
1.10231 Pounds	1 livre.
2.20462 Pounds	1 kilogramme.
14 Pounds = 1 Stone..	6,350288 kilogrammes.
0.0393 Inches	1 millimètre.
0.393 (approx. 2/5) Inches	1 centimètre.
3.93 Inches	1 décimètre.
12 Inches = 1 foot....	0,304801 mètre.
3. Feet = 1 yard.....	0.914402 mètre.
3 Feet 3.37 Inches.....	1 mètre.
3280.8 Feet (approx. 0.621 Mile)	1 kilomètre.
5280 Feet = 1 Mile....	1.60935 kilomètre.
1 Minim	0.061610 c c.
1 dram = 60 minims...	3.696 c c
1 Fluidounce = 8 drams	29.573 c c.
16 Fluidounces = 1 Pint	473.17 c c.
2 Pints = 1 Quart	946.33 c c.
1.05671 Quarts	1 litre.
1 Quart, 1 Fluidounce, 391.1 Minims	1 litre.
4 Quarts = 1 Gallon...	3.78533 litres

THE AMERICAN JOURNAL OF ROENTGENOLOGY

PUBLISHED BY PAUL B. HOEBER, NEW YORK CITY

Issued Monthly. Subscription, $5.00 per year. Advertising rates submitted on application. Editorial office, 480 Park Ave., New York. Office of publication, 67-69 East 59th Street, New York

OFFICIAL ORGAN OF
THE AMERICAN ROENTGEN RAY SOCIETY

President

D. R. BOWEN, M.D.,
922 S. St. Bernard Street, Philadelphia, Pa.

First Vice-President

ALBERT SOILAND, M.D.,
527 W. 7th Street, Los Angeles, Cal.

Second Vice-President

FRANK S. BISSELL, M.D.,
801 La Salle Bldg., Minneapolis, Minn.

Secretary

G. W. GRIER, M.D.,
8111 Jenkins Arcade, Pittsburgh, Pa.

Treasurer

WM. A. EVANS, M.D.,
32 Adams Ave., W., Detroit, Mich.

Executive Committee

HOLLIS E. POTTER, M.D., Chicago, Ill.
G. W. HOLMES, M.D., Boston, Mass.
HENRY K. PANCOAST, M.D., Philadelphia, Pa.

Publication Committee

GEORGE C. JOHNSTON, M.D., Pittsburgh, Pa.
A. W. CRANE, M.D., Kalamazoo, Mich.
ISAAC GERBER, M.D., Providence, R. I.

Librarian

H. W. Dachtler, 224 Michigan St., Toledo, Ohio

Editor

H. M. IMBODEN, M.D., New York, N. Y.

Associate Editor

PERCY BROWN, M.D., Boston, Mass.

THE CAMP GREENLEAF MEETING

The nineteenth annual meeting of the American Roentgen Ray Society, held at Camp Greenleaf, Fort Oglethorpe, Georgia, on September 6, 7, 8, and 9, was a most interesting one, due in part to the historical setting and the military surroundings. The attendance of members was larger than expected and was greatly augmented by instructors and students from the various special schools of medical instruction there located, especially from the school of Military Roentgenology. The following program was presented; and papers will be published in forthcoming issues of the JOURNAL.

WEDNESDAY, SEPTEMBER 4TH

Morning Session—9 A.M.—at Camp Greenleaf

1. ADDRESS
   BY THE COMMANDANT, Camp Greenleaf
2. THE ROENTGEN RAYS IN THE DIAGNOSIS OF CHRONIC APPENDICITIS AND OTHER CONDITIONS IN THE APPENDICULAR REGION
   GEO. C. PFAHLER, M.D., Philadelphia, Pa.*
3. LESIONS AT THE DUODENO-JEJUNAL ANGLE
   HARRY M. IMBODEN, M.D., New York City
4. ROENTGEN RAY EXAMINATION OF THE URETERS
   JOHN H. EDMONSON, M.D., Birmingham, Ala.
5. DIAGNOSTIC ERRORS FROM OVERLOOKING SIMULTANEOUS LESIONS
   A. W. CRANE, M.D., Kalamazoo, Mich.
6. COOPERATION BETWEEN THE ROENTGENOLOGIST AND OTHER MEDICAL OFFICERS
   CAPTAIN M. B. PALMER, M.C., U.S.A.

Afternoon Session—1.30 P.M.—at Camp Greenleaf

1. OSTEOMYELITIS
   MAJOR F. H. BAETJER, M.C., U.S.A.
2. HISTOLOGICAL APPEARANCES IN A SERIES OF BONE TUMORS COMPARED WITH THE ROENTGEN RAY FINDINGS
   MAJOR L. T. LE WALD, M.C., U.S.A.
3. OSTEOMALACIA—ITS ROENTGENOGRAPHIC APPEARANCE AND CLASSIFICATION
   GEO. W. HOLMES, M.D., Boston, Mass.
4. SOME OBSERVATIONS OF MASTOID STRUCTURE AS REVEALED BY ROENTGEN RAY EXAMINATION?
   ISAAC GERBER, M.D., Providence, R. I.
5. THE X-RAY INDICATIONS FOR EXTRACTION OF TEETH
   BYRON C. DARLING, M.D., New York City

*Read by title only.

6. A ROENTGENOLOGICAL CONTRIBUTION TO THE POSSIBLE CAUSE OF HEREDITARY OPTICAL ATROPHY
H. K. Pancoast, M.D., Philadelphia, Pa.

Evening Session—8 P.M.—*at Hotel Patten*

EXECUTIVE SESSION—FOLLOWED BY LANTERN SLIDE DEMONSTRATION
INSPECTION OF COMMERCIAL EXHIBITS

THURSDAY, SEPTEMBER 5TH

Morning Session—9 A.M.—*at Camp Greenleaf*

EXECUTIVE SESSION
SCIENTIFIC SESSION

1. MOBILE X-RAY APPARATUS
Lieut. Colonel A. C. Christie, M.C., U.S.A.

2. LOCALIZATION OF FOREIGN BODIES, WITH SPECIAL REFERENCE TO INFORMATION GIVEN TO THE SURGEON
Major Percy Brown, M.C., U.S.A.

3. SIMPLIFIED ADAPTATION OF CROSS-SECTION ANATOMY LOCALIZATION
Captain E. S. Blaine, M.C., U.S.A.

4. THE TRAINING OF MANIPULATORS
Major H. E. Ashbury, M.C., U.S.A.

5. INTERPRETATION BY A LINEAR METHOD
Major A. W. George, M.C., U.S.A.

6. HYDRO-PNEUMO-CRANIUM AND ALLIED PHENOMENA, WITH REPORT OF A CASE
H. E. Potter, M.D., Chicago, Ill.

Afternoon Session—1.30 P.M.—*at Camp Greenleaf*

1. STREPTOCOCCUS EMPYEMA—A STUDY OF THE CONDITION AS REVEALED BY THE X-RAY
Major W. H. Stewart, M.C., U.S.A.

2. SOME NON-TUBERCULUS PULMONARY LESIONS
Major A. W. Gray, M.C., U.S.A.

3. CONCERNING A ROENTGENOLOGICAL CONCEPTION OF PULMONARY TUBERCULOSIS
F. S. Bissell, M.D., Minneapolis, Minn.

4. THE UNSUSPECTED FOREIGN BODY AS A FREQUENT CAUSE OF CHRONIC BRONCHITIS
D. R. Bowen, M.D., Philadelphia, Pa.

5. PLEURITIS FROM THE STANDPOINT OF THE PATHOLOGIST
Major R. E. Keilty, M.C., U.S.A.

6. THE VALUE OF THE ROENTGEN RAY EXAMINATION IN STUDYING THE COURSE OF PULMONARY AND CARDIAC PATHOLOGY
Major L. G. Cole, M.C., U.S.A.

7. THE SIGNIFICANCE OF ANNULAR SHADOWS ON CHEST PLATES
William A. Evans, M.D., Detroit, Mich.

Evening Session—8 P.M.—*at Hotel Patten*

ANNUAL DINNER.

INSPECTION OF COMMERCIAL EXHIBITS.

FRIDAY, SEPTEMBER 6TH

Morning Session—9 A.M.—*at Hotel Patten*

EXECUTIVE SESSION
SCIENTIFIC SESSION

1. THE USE AND ABUSE OF ROENTGEN RAY TUBES
C. N. Moore, Schenectady, N.Y.

2. THE PRACTICAL USE OF THE WHEATSTONE STEREOSCOPE
H. C. Snook, Chicago, Ill.

3. THE PHOTOGRAPHIC MEASUREMENT OF X-RAY DOSAGE
L. P. Larkin, Ithaca, N.Y.

4. THE PHYSICAL CHARACTERISTICS OF FLUORESCENT INTENSIFYING SCREENS AS APPLIED TO ROENTGENOLOGY
M. B. Hodgson, Rochester, N.Y.

5. ROENTGENOLOGY IN ITS RELATION TO ORTHOPEDIC SURGERY
Major John Ridlon, M.C., U.S.A.*

6. SKIN LESIONS IN SOLDIERS SUCCESSFULLY TREATED BY ROENTGEN RAYS
G. M. McKee, M.D., New York City*

* Read by title only

Afternoon Session—1.30 P.M.—*at Hotel Patten*

1. X-RAY WORK IN THE NAVY
   L. MARSH DALLOWAY, P.A.SURG., U.S.N.R.F.

2. A RÉSUMÉ OF THE ROENTGEN FINDINGS OF 205 CHEST EXAMINATIONS AT A BASE HOSPITAL IN FRANCE
   LIEUTENANT R. G. ALLISON, M.C., U.S.A.*

3. LE MAL DES IRRADIATIONS PENETRANTES [The penetrating Irradiations Sickness] *
   MEDECIN A. BECLERE OF THE ACADEMY OF MEDICINE, PARIS

4. ADDRESS AU MEDECINE RADIOLOGISTES DE LA SOCIETE AMERICAINE ROENTGEN [Greetings to the American Roentgen Ray Society] *
   MEDECIN-MAJOR (FIRST CLASS) HARET

5. PERTHES' DISEASE—OSTEOCHONDRITIS
   LIEUT. E. L. JENKINSON, M.C., U.S.A.*

* Arriving too late to be read in their entirety, the starred numbers were read by title only—as was also a paper on the "Instruction of War Roentgenologists" by Major Ledoux-Lebard of Tours, France, which appears in this issue of the JOURNAL.

ANOTHER AVENUE OF CONSERVATION

The especial attention of all users of Roentgen Ray tubes is directed to the request for platinum which is made by the War Industrial Board and which is printed on page 478 of this number of the JOURNAL. Platinum is found in all gas tubes in the "seal in" portion of the terminals. All of us have a number of gas tubes which are punctured, broken, cranky or for some other reason have been passed to the junk pile. The Board urges that the platinum in these tubes be recovered and made available for government purpose.

GREETING

The Western Roentgen Ray Society felt that it would fill a wider field of usefulness by having its own official organ. Accordingly they have put forth THE JOURNAL OF ROENTGENOLOGY. The May Number being Number 1 of Volume 1 we bid it welcome to the field of American roentgenological journalism and hope it may have a steady growth and a useful career.

TRANSLATIONS & ABSTRACTS

Pool, E. H., Lee, B. J., and Dineen, P. A., Surgery of Soft Parts, Bones, and Joints. At a Front Hospital. (*Surg., Gynec. & Obst.*, Vol. XXVII, No. 3, 1918, p. 289.)

"The Ambulance l'Ocean at La Panne, Belgium, under the management of Colonel Depage, is one of the best known hospitals in Europe."

"La Panne is a small summer resort on the coast of Flanders, East of Dunkerque and Calais and about six miles from Nieuport-Bains, which marks the northern limit of the Western Front. It is composed of a former hotel with surrounding villas and a number of recently built wooden barracks. It can accommodate about 1,000 patients. An auxiliary hospital is in course of construction at Vinckem, about nine miles south of La Panne, and about six miles west of Dixmude, the center of the Belgian lines. The hospital at Vinckem consists of frame buildings of the barrack type. It is planned for 1,400 beds and can be readily expanded to a larger capacity."

The admitting officer is a roentgenologist who is also the director and is responsible for the coöperation of the assistants and the coördination of the work.

The roentgenological department is of necessity one of the most important features in such a hospital. Practically all cases must pass through it, and the results of the early operations depend largely upon the thoroughness of the roentgenologist's examination and the accuracy of his findings and report. The efficiency of such a department depends largely upon the ability and trustworthiness of the man doing the work. At La Panne a roentgenologist is always on duty.

A patient is taken to the *x*-ray room as soon as possible after admission, before or after being put to bed according to the indications of the case. The routine method employed in a new case depends upon the site of injury. Thus, in difficult cases, such as shoulder, hip, gluteal region, thigh, thorax, and abdomen, the bathymetre of Dessanes is used. For the cranium, plates are always made at once, because it is often difficult to recognize small foreign bodies. For simple cases, such as leg, forearm and arm, the Ledoux-Lebard bonnet is employed; the part is examined from different angles and the depth estimated. In most cases, an effort is made to cause the foreign body to move during fluoroscopy. For this purpose, pressure is made on the skin over the foreign body with the tip of a curved metal rod. Where the foreign body moves most freely, it is probably closest to the skin.

In an incredibly short time, Dr. Peremans localizes all eclats. He marks on the skin the point under which each one lies, making the mark as nearly as possible in the line of, or in relation to, the probable incision. This is usually quite accurately done because the roentgenologist in question has a good knowledge of war surgery and keeps in close touch with the surgical work of the institution. Such coöperation between the surgical and roentgenological departments is of great value, but it necessitates the employment of a broadly trained medical man as roentgenologist. It appears imperative in a hospital doing a large amount of work.

On the history chart, which has already been filled out, is made a note somewhat as follows: "Right thigh, eclat 10 x 55 millimetres, 65 millimetres in depth, under the point marked on skin." Or in a case with fracture, "left leg, fracture of both bones, middle third, much comminution."

Plates of fractured bones are also made, as a rule, at the time of the first examination. If the operator wishes further information, Dr. Peremans is always available and goes to the operating room where his advice is often of much value. With experience the operator acquires the knack of finding foreign bodies quite readily when they have been localized as above indicated. One should remember, however, to mark with a scalpel the points indicated on the skin before painting with iodine. For localization in later cases, especially in difficult regions, such as thorax, brain or pelvis, reliance is placed chiefly on the Hirtz compass. We saw astonishingly accurate localizations by this method. One of us removed an eclat about one centimeter in diameter from the psoas muscle within the pelvis through a trephine opening in the ileum. The foreign body had been localized exactly as to depth and closely as to direction by this method. We

likewise saw a small eclat, which lay at the base of the brain in the middle fossa, removed through a trephine opening in the temporal region. In this case, the central rod of the Hirtz compass was introduced to the depth and in the direction established before the operation, the legs of the compass being on the respective points previously marked on the skin. A powerful electromagnet was then placed in contact with the rod which was withdrawn. Attached to it was the foreign body.

For the late removal of foreign bodies from regions in which the field of dissection is not of necessity limited, especially for very small foreign bodies, the method of Ombredanne-Ledoux-Lebard is often employed. For this purpose an operating room is attached to the *x*-ray Department. The room, which can be darkened by shades, is next to the night operating room, from which supplies are furnished. The table is the Ledoux-Lebard pattern with bulb beneath, and protected on three sides by lead aprons.

Plates are always made in examinations subsequent to the initial fluoroscopic observation. In the case of fractures, frequent observations are made.

A movable apparatus is available for use in the wards. For the localization of foreign bodies it is little used. Even bad cases are brought to the *X*-ray room, because localization is much better done on a fixed table. For fractures, however, the movable apparatus is imperative; proper treatment in a large proportion of cases demands frequent *x*-ray examinations without disturbing the patient.

Records of plates for filing with histories are made on tracing paper. The bones are filled in with a soft carbon pencil and this is covered with varnish to prevent smearing.[1] Beautiful and quite accurate records are thus made.

The roentgenological department is managed by two doctors (Dr. Henrad and Dr. Peremans), assisted by two brancardiers, who develop the plates. There is no clerk or stenographer.

An estimate of the work demanded may be had from the following figures:

650 consecutive cases; 110 patients *x*-rayed with plates, average 3 plates; 350 fluoroscopic examinations.

The apparatus is the grand Contact Tournant de Gaiffe, 220 volts, direct. Coolidge tubes are used exclusively. The Bilot table is used in the main room, the Ledoux-Lebard table in the operating room."

[1] Venice turpentine 6¾ per cent. in alcohol.

JAPIOT. The Posterior Malleolus. (*Progrès méd.*, March, 1918, p. 104.)

The author gives the name of posterior malleolus or the third malleolus to the posterior lip of the tibia, a bony projection which very plainly projects farther down than the anterior border of the bone. He claims that the posterior malleolus impedes displacement of the foot posteriorly when jumping.

For the roentgenographic examination of the posterior malleolus, two plates are necessary, one anteroposterior and one lateral. For the lateral plate, the internal malleolus rests on the plate and the tube is centered over the middle of the joint space. For the anteroposterior plate the heel rests on the plate and the tube is centered over the middle of the joint space. To show better the posterior malleolus it is very good to have a small sand bag under the heel.

In the lateral roentgenograph the shadow of the posterior malleolus is superimposed upon the shadow of the exterior malleolus from which it is very difficult to differentiate when there is a fracture present. To differentiate between the two, it is necessary to trace the contour of the malleolus and the posterior surface of the third malleolus by tracing down the posterior border of the tibia. In tracing the anterior border of the third malleolus in the anterior posterior plate, two landmarks are found; the posterior lip of the tibial surface and the posterior tubercle of the tibiofibular groove.

The posterior lip of the tibial surface is almost parallel to the other lines, which are the articular surface itself and the astragalus. If the foot is sufficiently elevated the posterior lip is superimposed over the shadow of the astragalus or the anterior malleolus which borders this side of the third malleolus. Of the two tubercles which border the tibiofibular groove, the anterior one, farthest away from the plate, is the greater and projects over the shadow of the fibula; the posterior one, closer to the plate and therefore less distorted, is more marked. It describes a curve more accentuated a few millimeters at the side of the fibula.

These relations of the posterior tubercle to the fibula on an anteroposterior roentgenograph must always be very carefully observed. It is a very important diagnostic fact in the condition of the posterior malleolus and, especially, by the relation of the astragalus to the lateral malleoli. These findings are important when we have to do with a fracture of the posterior border or the third malleolus (Destot). In an important case of a posterior fracture of the foot and in every fracture of both malleoli of the ankle joint, it is very important to ascertain the condition of the posterior malleolus. The fracture of the posterior malleolus alone is probably always so rare because it is not sufficiently looked for. It is usually hidden under the signs of a sprain and a systematic roentgenographic examination of a serious sprain would without doubt reveal a much larger number of isolated posterior fractures of the malleolus. P. LUND

KANTOR, JOHN L. A Study of Atmospheric Air in the Upper Digestive Tract. (*Am. J. M. Sc.*, June, 1918, p. 829.)

1. From the earliest ages of medicine the presence of air in the digestive tract has played a certain significant part, and the literature on this subject is very voluminous. Hippocrates wrote a book on "Winds and Flatuosities" and many other ancient writers wrote extensively on this subject. In the last century men like Ewald, Schultz, Boas and many others, mostly Germans, were interested in the investigation of gases of fermentation and putrefaction in the stomach. Although these contributions were interesting, they threw light only on one pathological condition, namely, pyloric obstruction with gastric fermentation. Of far greater importance were the later experiments of Schierbeck, Giglio, and Yllpo, showing that the basis of gastric gases under normal conditions is constituted by swallowed atmospheric air. Magendie found that air-swallowing was a rather frequent and, in many cases, an acquired condition. Although many great physiologists have studied this question thoroughly, it was never fully understood that air-swallowing is a perfectly normal physiological process, until Bouveret in 1891 published his experiments on this subject, and his expression "aërophagia" and his views were accepted and confirmed by a large amount of workers. The *x*-ray observations were first reported by Abrams in 1898, and later on by a great number of roentgenologists.

2. Although it is now generally recognized that aërophagia is a normal condition, there is still a doubt that the derivation of the stomach gases is entirely from the atmospheric air. Some writers claim that this is the case, while others are of the opinion that there is a sudden relaxation of the pylorus with regurgitation of intestinal gases or of alkaline duodenal contents into the acid stomach with a consequent liberation of carbon dioxide. Hoppe-Seyler's theory is that there is a marked difference in the amount of carbon dioxide found in the stomach and in the amount in the atmosphere. The amount regained from the stomach was at least equal to, if not larger than, the carbon dioxide in the atmosphere: this is a proof of the old theory of "alimentary respiration."

3. *Air Swallowing.*—The author found that this physiological action is present in a great majority of people; while some people are unable to perform it, others do it unconsciously all the time. This act can either be conscious or volitional, subconscious or reflex. Air enters the stomach in two ways, either with food or alone. The first way occurs in every individual and is a subconscious act; it is found by experimenting that the second swallowing sound, heard over the cardia 5-7 seconds after deglutition, was caused by the entrance of air into the cardia (Meltzer and Kronecker, 1883, 1887). Hertz (1907) and Kraus (1912) tried to show under the fluoroscope how the second sound was caused by air penetrating into the stomach. To establish more precisely the relation of penetration of air into the stomach to the swallowing sound, the author studied ten normal men with a combined fluoroscope and auscultating procedure, while giving them the standard opaque meal. He found that the bubble of air was always present on top of the food, while going through the esophagus, and that the second swallowing sound was always heard with the disappearance of the last portion of food; it was, of course, impossible to recognize as such the passage of air into the stomach when it preceded and even followed the opaque shadow, but when a bubble

of air was completely incorporated within the bolus the characteristic sound was heard as it passed the cardiac boundary. When the observation was made in the reclining position, a succession of sounds was heard as the whole bolus divided up in fractions and the air also passed through the cardia in fragments. The production of the swallowing sound seems to be due to two factors: the presence of air in the bolus and the force of gravity. If the cardia is open when the bolus of food arrives, some of the air may precede the food, and so produce the first swallowing sound, while if the cardia is contracted, the air rises to the top of the fluid, and we get only one sound, the second swallowing sound.

In the fasting condition there is, as a rule, no distinct *Magenblase* or air bubble. With the first swallowing sound a clearly defined bubble of air appears and increases in dimensions after each swallowing. In the stout individuals with high oblique stomachs the *Magenblase* appears flat, and the swallowing sound becomes fainter and fainter until the air is discharged and the swallowing sound restored. On the other hand, in individuals with ptotic stomachs, the *Magenblase* retained its round form, and the swallowing sound was loud and unchanged throughout the entire filling.

The actual amount of gas ingested seems to depend very much on the condition of the cardia. If the swallowing sound is heard after each deglutition, the cardia is patent, while if it is less relaxed, a smaller amount of air is admitted and only one swallowing sound is heard when the whole column of food from many deglutitions enters the stomach.

The swallowing of air alone or "air gulping" is the second way of aërophagia; if the cardia is relaxed and a good force is applied to a so-called "empty" swallow, one may see the air enter the stomach two seconds after the empty deglutition. Many writers claim that certain respiratory phenomena accompany the air-swallowing, but the author finds that air enters into the stomach as easily during deep inspiration as in deep expiration.

4. Fate of air in the stomach: Most of the air escapes through the esophagus by eructation—a true reflex act caused by different factors, such as the intragastric pressure, the gastrohyperesthesia, posture, acidity, peripheral reflexes, belching and further aërophagia. Some air might escape into the intestines, or be absorbed by the mucosa, especially if there is oxygen.

The summary of Dr. Kantor's experiments and studies leads us to the following few main points:

1. Gaseous accumulations in upper digestive tract have atmospheric air as their basis.

2. Air is introduced with food or by "gulping."

3. Gravity causes the difference between the swallowing of air and of food.

4. By fluoroscopic observations it is demonstrated that the so-called swallowing sounds are produced by the entrance of air into the stomach.

5. The act of deglutition consists of three instead of two classic periods; beside the buccopharyngeal and the esophageal, we have the period of the receptive relaxation of the stomach and the inhibition in cardiac tone—the cardiogastric period.

MANTOUX AND MAGNOT. Les images cavitaires dans la tuberculose pulmonaire. (*Revue de La Presse Médicale. Arch. d'electric méd.*)

The authors, experts in the roentgenography of tuberculosis of the lungs, describe the varied aspects of the cavity according to its content of fluid or air, or to the position of the patient. These are the shadows which Bouchard described, but the present authors give the following roentgenographic interpretations:

"On an area more or less extensive, rather dense in character, are seen darker lines, forming a series of incomplete circles, which superimpose on one another and circumscribe clearer areas. The whole reminds one of crumbs of bread well raised, with its unequal and multiple alveoli; therefore, let us give this the name "bread-crumb appearance." At the moment of coughing the bread-crumb image is liable to change its appearance and outline.

Another appearance of cavities is described. The shadow is markedly different, all the clear spaces having almost the same dimensions, about 1 centimeter in diameter. Often the smaller ones have a polygonal shape, and are very slightly separated and occur only a few in a group; they are usually seen on a gray shadow and on account of their shape they are named the "honeycomb appearance."

The "honeycomb" appears mostly in the upper half of the lungs. It is not seen fluoroscopically and is visible only on plates. At the moment of coughing the "honeycomb" shadow changes less in position than the "bread-crumb" shadow.

These two classes of roentgenographic shadows are characteristic. The "bread-crumb" appearance is more frequent than the "honeycomb." The bread-crumb and honeycomb appearances coincide very often with the air-bubble shadow and are found only in one of seven cases of confirmed fresh tuberculosis. They did not appear once in 250 healed up and suspect cases of tuberculosis.

The auscultating signs confirm in four-fifths of the cases the presence of cavities revealed by bread-crumb and honeycomb shadows. The post-mortem examinations have constantly shown small or middle-sized cavities in the region of the lungs where the *x*-ray had revealed these shadows.

Without stating that the bread-crumb or honeycomb shadows are pathognomonic of tuberculous cavities, they might be considered most characteristic signs. P. LUND